A Work Project, presented as part of the requirements for the Award of a Master Degree in Finance from the NOVA – School of Business and Economics.

Equity Research – Advanced Micro Devices (AMD)

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A Project carried out on the Master in Finance Program, under the supervision of:

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Abstract

Advanced Micro Devices (AMD) is a Silicon Valley-born semiconductor company, that had its IPO in 1972. Despite its rough past, in the most recent years, AMD has been able to gain competitive advantage in relation to its industry peers, as well as market share due to its continuous innovative products' lines of EPYC and Ryzen processors, and Radeon graphics. Furthermore, recently established partnerships and launched products give the company good growth prospects, in the near future.

For these reasons an Equity Research Report was conducted on AMD, in order to get to a fair value of the stock. AMD's valuation in the report was assessed through the Discounted Cash Flow (DCF) method, considering various factors that could affect the company's financial statement line items. Among those factors are the Average Selling Price of its products, Units Shipments, Gross Margin, investments in innovation (R&D), and several partnerships alongside with the company's Market Share. A scenario analysis on the effects of the tariffs, coming from the Trade War, was also conducted on AMD's price.

The price target arrived for December 31, 2020 was **$52.75**, leading to a **BUY** investment recommendation, considering normal market conditions.

Keywords: AMD, 2nd Gen EPYC Processors, Trade War and Semiconductor Industry.

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ADVANCED MICRO DEVICES

COMPANY REPORT

SEMICONDUCTOR INDUSTRY

3 DECEMBER 2020

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AMD's Market Momentum

2nd Gen AMD EPYC processors ("Rome")

- The release of the 2nd Gen EPYC processors by AMD, allowed the company to gain market share to Intel, that, over the previous years, owned almost 99% of the server market. The market share of AMD was around 3% at the beginning of 2019 and now it is estimated to be almost 5%, with the possibility of it reaching 10% until the end of 2020.
- This significant short-term gain of market share can be explained not only by the record performance increase of such products (that doubled the performance of the previous generation), but also by the competitive prices AMD offers (a total cost of ownership between 25% and 50% lower than the one of related products). Offering lower prices, compared to its peers, has been the main strategy of the company in earning market share and standing out in the industry.
- As well, Intel had been struggling with the release of its 10nm products, that were supposed to be launched at the end of 2016. This long delay, that lasted until late 2019, gave advantage to AMD, which had already released its 7 nm products.

Company description

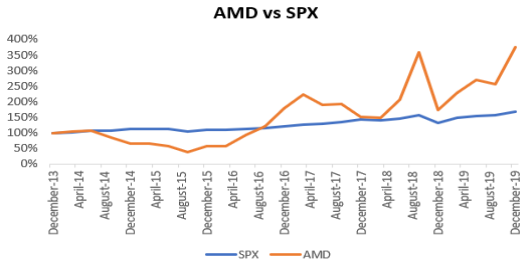
Advanced Micro Devices, Inc. is a global semiconductor company that offers products such as x86 microprocessors, as standalone devices or as incorporated into an accelerated processing unit (APU), chipsets, discrete graphics processing units (GPUs) and professional GPUs. Additionally, it offers server and embedded processors, semi-custom System-on-Chip (SoC) products and technology for game consoles. The Company also licenses portions of its intellectual property portfolio.

Recommendation:	**BUY**
Price Target FY20:	**$52.75**
Price (as of 31-Dec-2019)	**$45.86**

Source: Bloomberg

52-week range (€)	$16.94 - $47.31
Market Cap (€m)	51,070.96
Outstanding Shares (m)	1114
Total shareholder's return	15.03%

Source: Bloomberg; Company data; Valuation model



Source: Bloomberg

(Values in $ millions)	2018	2019E	2020F
Revenues	$6,475	$7,733	$10,933
EBITDA	$658	$912	$1,860
EBIT	$451	$617	$1,463
Net Income	$337	$253	$747
EPS	$0.35	$0.24	$0.67
P/E	54x	193x	79x
Gross Margin	40.42%	42.00%	48.00%
FCF	$(338)	$458	$808

Source: Bloomberg, Company data; Valuation model

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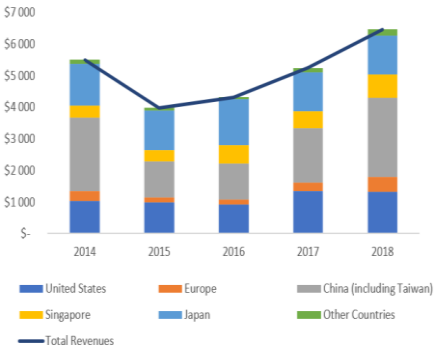
Company overview

Exhibit 1: Regions where AMD is located

Source: Company's Website

Exhibit 2: Revenues per Geography (million $)



Source: Company's Annual Reports

Advanced Micro Devices (AMD) was founded in 1969, by Walter Jeremiah Sanders, head starting its business in Silicon Valley. Today, with its most recent headquarters located in Santa Clara, California, the company develops high-performance computing and visualization products, making them one of the major players in the Semiconductor Industry. Geographically, AMD is present in several regions of North America, South America, Europe, Asia and Oceania. The company is known for being able to keep offering faster and innovative chips, while still competing at the lower price range of the markets in which it operates, both the **Graphics processing unit (GPU)** market and the **Central processing unit (CPU)** market. This is shown in more detail in the Key Value Drivers Section.

In terms of Revenues, from 2015 to 2018, the company presented a growth of around 62% and depends mostly on **China (including Taiwan)** and on the **United States**, which represented 39% and 21%, respectively, in 2018 (**Exhibit 2**).

AMD started as a second-source manufacturer of computer chips and, since then, it has been expanding steadily, basing its growth on product quality. From 1982 to 1986, the company had an agreement with Intel Corporation, supplying it with second-source chips. In 1996, AMD acquired a microprocessor company called **NexGen**, best known for the distinctive implementation of the x86 architecture in its processors. Later on, in 2000, the company introduced the Athlon processor, which was designed to run the Microsoft Corporation's Windows operating system. With the launch of this product, the company became the first to produce a 1-GHz (gigahertz) microprocessor, marking it as a significant competitor in the chip market.

Continuing to grow, AMD acquired **ATI Technologies**, in 2006, in order to expand its business into the graphics market. The acquisition enabled the company to offer products such as graphic chipsets used in several devices, such as high-end PC's and cell phones. In 2008, AMD announced plans to spin off manufacturing operations in the form of a joint venture known as **GlobalFoundries Inc**. The partnership and spinoff allowed AMD to focus exclusively on chip design. More recently, AMD has passed most of its **7nm products** production to **Taiwan Semiconductor Manufacturing Company (TSMC)**.

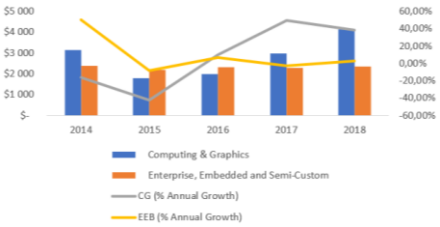
Due to the natural tendency of the semiconductor industry to have a natural monopoly in its subsegments, authorities have an active role in its regulation. One example of this is AMD itself, which has an history of legal disputes with Intel. In order to settle them, both companies entered into a cross-license agreement under which AMD granted to Intel, and Intel granted to AMD, non-exclusive, royalty-free licenses to all of

each other's patents. Each party can exploit these patents for making and selling certain semiconductor and electronic-related products.[1]

Furthermore, AMD has an history of **restructuring plans**, having implemented several along the years (the latter ones in 2014 and 2015). All restructurings aimed to improve the company's cost structure and to strengthen its competitiveness in core growth areas. Overall, the plans involved workforce reductions (around 6% in 2014 and 5% in 2015), asset impairments, the consolidation of certain real estate facilities and, more recently, organizational actions such as outsourcing certain IT services. The operational savings from the most recent restructuring plan were expected to be about 48 million dollars, in 2016. Since 2015, AMD's net income has been growing, being positive only in 2018, of approximately 337 million dollars.

Segments and products

Exhibit 3: Revenues per Business Unit (million $)

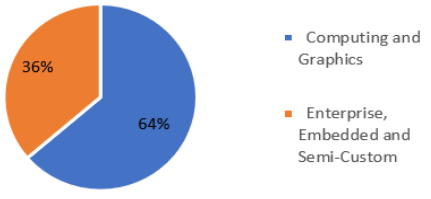


Source: Company's Annual Reports

With AMD's presence in different markets, the company is divided in two main business units that are the **Computing and Graphics segment**, which primarily includes desktop and notebook processors (CPUs), microprocessors and chipsets, discrete and integrated graphics processing units (GPUs), and datacentre and professional GPUs; and the **Enterprise, Embedded and Semi-Custom segment**, which primarily includes server and embedded processors, semi-custom System-on-Chip (SoC) products, development services and technology for game consoles.

The products that most characterize AMD in the market, and which have been the main image of the company's turning point, aiming at becoming market leader, are its products' families called **Ryzen** and **EPYC**. These are the company's best solutions for Server and Embedded processors, as well as notebook and desktop PCs. AMD is also betting on the Graphics market through the launch of new **Radeon** products, in order to gain market share to one of its strongest competitors, Nvidia. Besides this, as is typical in the semiconductor industry, the company has numerous cross-licensing and technology exchange agreements with other companies, like the one aforementioned with Intel, under which they both transfer and receive technology and intellectual property rights.

Exhibit 4: Revenues per BU (2018) (million $)



Source: Company's Annual Report

Overall, the **Computing and Graphics segment** has been the one with a higher impact in terms of revenues, except in 2015 and 2016, and, since 2016, with the higher percentage annual growth. From **Exhibit 3**, it is possible see that, from 2016 to 2017, it presented a growth of almost 50%, due to an increase of 38% in the average selling price and an increase of 1% in unit shipments. The increase in the average selling price was largely motivated by the sales of Ryzen desktop processor and Radeon graphics products, and the increase in unit shipments was mainly driven by a higher demand for

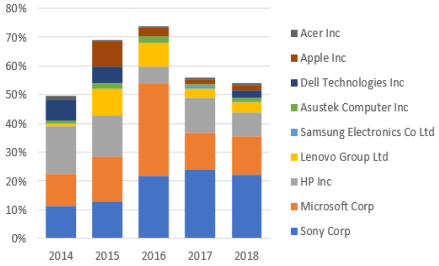
[1] Source: Company's Annual Reports

the Radeon graphics products. From 2017 to 2018, the segment presented a growth of almost 40%, as a result of a 15% increase in the average selling price and a 17% increase in unit shipments, both driven by a higher demand for the Ryzen processors. The segment's revenues, in 2018, were around 4125 million dollars, contributing for 64% of the company's total revenues (**Exhibit 4**).

Relatively to the **Enterprise, Embedded and Semi-Custom segment**, the major revenue growth was verified from 2013 to 2014, being it approximately **51%**. This happened because of a rise in net revenue connected with higher unit shipments of the semi-custom SoC products, which started shipping in the second quarter of 2013, due to the launch of **Playstation 4** (by Sony Corporation) and **Xbox One** (by Microsoft Corporation), both containing AMD's products. The recent growth of the sector is linked to higher sales of AMD's EPYC server products. During 2019, AMD launched the 2nd Gen AMD EPYC processors, which are expected to be integrated in several partnerships made with other companies, stated later on this report. The segment's revenues, in 2018, were around 2350 million dollars, accounting for 36% of the company's total revenues.

Historically, the **strongest customers** of the company have been **Sony Corporation**, **Microsoft Corporation** and **HP Inc.** representing, respectively, around 22%, 13% and 9% of total revenues in 2018. Still, it is possible to see a diversification of revenues' sources throughout the years, which is a sign that AMD is not as vulnerable as before to a change in the preferences of some of its main customers. Despite of the company still having some specific customers representing around 45% of its sales, the recent diversification makes AMD's fundamentals more robust due to its lower level of dependency on specific customers (**Exhibit 5**).

Exhibit 5: Customers – Biggest Market Players (% of AMD's Revenues)

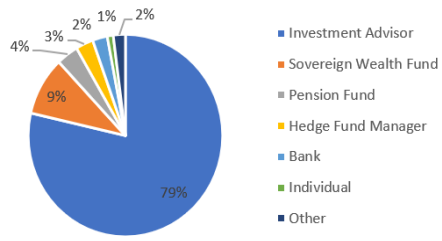


Source: Bloomberg

Shareholder's Structure

Advanced Micro Devices did its IPO on September 27, 1972, issuing about 620 thousand shares of common stock, over-the-counter, at $15.50 per share, raising a total of 7.5 million dollars. Later, on October 15, 1979, AMD entered on the New York Stock Exchange (NYSE) and then passed to the Nasdaq Stock Exchange on January 2, 2015. As of **31st December 2019**, it had aproximatelly **1114** million outstanding shares of common stock, trading at **$45.86**, having a market capitalization of **51071** million dollars. Concerning the ownership type, **Exhibit 6**, a great percentage of AMD's shares is owned by **Investment Advisors**, with around 79% of the total shares outstanding, which underlines AMD's stock as an important holding. Among the top Institutional Investors are the Vanguard Group, Inc. (11.03%), BlackRock Institutional Trust Company (5.06%), Mubadala Investment Company PJSC, N.A. (4.82%), Fidelity Management &

Exhibit 6: Ownership Type (2019) (% of total shares outstanding)



Source: Bloomberg

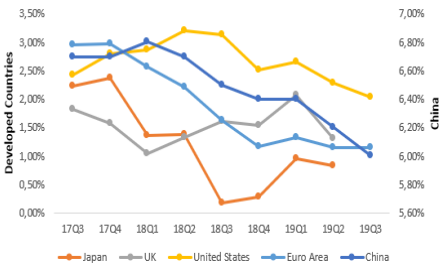
Research Company (4.68%), State Street Global Advisors (3.77%), Wellington Management Company, LLP (3.15%) and JP Morgan Asset Management (3.11%)[2]. This structure might represent a source of risk to AMD, as these top seven owners combined hold almost 37% of the company, which may cause distortions in the decision-making process. With this amount of ownership, the investors have a lot of power in terms of voting rights, which may cause agency problems.

Macroeconomic Overview

Exhibit 7: Stock Market's Performance (Cumulative returns)

Source: Bloomberg

Exhibit 8: GDP Growth Rate



Source: OECD

The year of 2019 has been the recovery year for most of the world's markets, which ended 2018 exposed to a lot of market shocks, coming, mainly, from the political uncertainty surrounding the **Brexit deal** and the **Trade War**. Still, as it is possible to see in **Exhibit 7**, these market shocks, created mostly by political uncertainty matters, leaded to a sense of fear on investors. By looking at the cumulative returns of indexes like the **S&P 500 (U.S.)**, the **FTSE 100 (U.K.)**, and the **Shanghai Composite (China)**, it is noticeable that all of them hit 1-year lows around January 2019, with cumulative returns for the year in the range of **-20%**. This was the time where trade tensions between the United States and China aggravated with the cancelation of several meetings between both countries, due to disagreements. Adding to this, the U.K. was entering in its latest year to do a deal with the European Union for its exit, and there were still a lot of uncertainty between government parties on the Brexit deal terms.

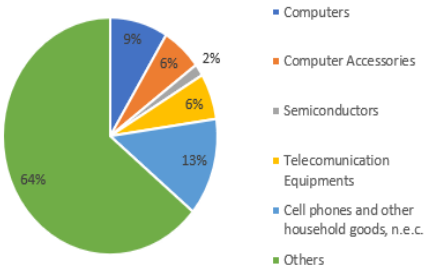
Despite all these uncertainties surrounding the world's major economies, in 2019, it was possible to see that most of them were able to stabilize its GDP Growth Rate, which was presenting a deceleration trend since the third quarter of 2017. From **Exhibit 8**, it is also possible to infer that countries like the **United States** and the **U.K.** presented a short period of GDP acceleration in the 1st Quarter of 2019, with **GDP growth rates of 2.07%** and **2.65%**, respectively.

Since 2018, **China** and the **United States** have been involved in a **Trade War**, regarding tariffs that have been applied on each other's exports/imports. This aggravated the environment of bad sentiment in the market, which was very evident, for example, in the **S&P 500** during the most critical time of the war, around January 2019. During 2019, the Trade War affected both countries' growth, since some tariffs have already come into effect.

According to SIA commissioned research, completed at the beginning of the year, the net impact of the additional tariffs on IT products would decrease the U.S. GDP growth by 0.9% in 2019, and 0.3% in 2020 from the baseline Economist Intelligence Unit (EIU) forecast of 2.5% GDP growth in 2019 and 0.8% in 2020.

[2] Source: AMD's Website

Exhibit 9: U.S. Imports from China (2018)

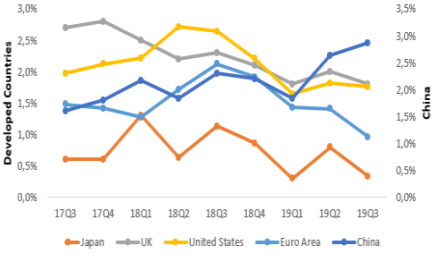


Source: United States Census Bureau

Exhibit 10: AMD vs Semiconductor ETFs (Cumulative returns)

Source: Bloomberg

Exhibit 11: Inflation CPI (% YoY)



Source: OECD

The outcome of the Trade War has a direct implication on **investors' sentiment** towards stocks from specifics markets, among which is the Technological sector from where Semiconductor companies are a part of. This happens because most semiconductor companies, like AMD, have some of its **production in China** (in AMD's case the exposure to China is even higher, since about **40%** of its **sales** come from this country), just like most of its Original Equipment Manufacturers (OEMs), which are the companies to whom they sell their chips to be incorporated in other devices, like Personal Computers and Smartphones. Also, semiconductor chips are incorporated in almost all the products that could get impacted by tariffs. Adding to this, about **36%** of the U.S. imports from China are related with the technological sector (**Exhibit 9**). So, in times when there is bad news on the Trade War, not only does the country's growth and consumer sentiment are affected, but also companies from the Semiconductor Sector, and other China exposed sectors, will tend to see its stock price drop. This adds up to the volatile environment that chip related stocks face all the time. The effect of the Trade War in AMD's valuation is analysed in more detail in the End Markets and Risk Factors Section.

In **Exhibit 10**, it is evident the influence that the market shocks, described above, have on Semiconductor stocks (represented by the two major Semiconductor sector Benchmark Indexes, the **PHLX Semiconductor Index (SOX)** and the **VanEck Vectors Semiconductor ETF (SMH)**, and by AMD). At the same time the market was feeling the effects of the political uncertainty issues, the Semiconductor sector's returns were also hitting 1-year lows. In the graph, it is also possible to observe AMD's outperformance in the Semiconductor sector, relative to the stated benchmark Indexes. AMD presented cumulative returns of almost 350% between January 2018 and November 2019, while both sector indexes presented cumulative returns, for the same period, in the range of 130% (the secondary Axis refers to AMD's cumulative returns).

Another important matter in the market, that is affecting monetary policy around the world, are the low inflation levels (**Exhibit 11**). Some countries have been feeling difficulties in achieving the thresholds they set for the inflation rate. For example, in the United States, the **Fed** had set its **target inflation** at around **2%**, which was not possible to attain, due to the described political conjecture. This causes the Fed to take actions on monetary policy, by lowering its reference interest rates, in order to stimulate economic growth, thus stimulating the growth rate of prices. Just in 2019, the Fed has applied three interest rate cuts, something that, despite being expected, is still seen by the market has "soft", which ends up being reflected on the stocks' prices.

Long-Term Growth Rate

In terms of future perspectives, the **OECD** predicts that the **United States** economy will grow at an average of **1.91%** per year between 2025 and 2060, while **China** is

expected to grow at an average of **2.09%** per year for the same time period (both rates regarding GDP real values). From this data, it is also possible to conclude that it is expected that the United States economic growth will accelerate throughout the years, while China's economic growth will decelerate. Both countries are expected[3] to achieve and maintain, over these years, their **inflation target** of approximately **2%** and **3%** (United States and China, respectively).

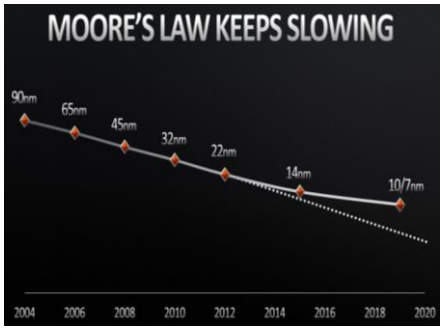
As AMD is mainly exposed to China and the United States, with about 60% of its revenues coming from these two countries combined (2018), the projected Long-term Growth Rate for the company, in real terms, is a weighted average of the two pedictions of both countries' GDP growth rates, giving a value of approximately **2.03%**. In order to arrive at the nominal Long-term Growth Rate (**4.09%**), the following calculation was performed:

I. Nominal Growth Rate = (1 + Weighted Average Real Growth Rate) x (1 + U.S. Inflation) – 1.

The Sector

Semiconductors and the Moore's Law

Exhibit 12: Moore's Law



Source: AMD's Website

Much of the growth in the semiconductor industry, over the last three decades comes from the **industry's "rule of thumb"**, where success depends on creating smaller, faster, and cheaper products. The benefit of being tinier is that it will be easier for it to fit and adapt the most recent technological devices that incorporate them, while having more power on the same chip, causing it to work faster. This creates fierce **competition** in the industry, and as new technologies lower the cost of production per chip, the price of a new chip might fall up to 50%, within a matter of months. These trade-offs led to an observation by Gordon Moore, the co-founder of Fairchild Semiconductor and Intel, who wrote a paper, in 1965, describing the perception that the **number of transistors on a microchip doubles every two years, though the cost of computers is halved**. This became known as Moore's Law and started to guide the pattern of modernization in the semiconductor industry, especially in the companies' long-term planning and targets' setting for **research and development (R&D) spending**. After 1975, an Intel executive, David House, predicted that chip performance would double every 18 months. The evolution of the chips' size (y-axis) in nanometres (nm) along the years (x-axis), for the **overall industry** is shown in **Exhibit 12**, where the dash line is the trend predicted by the Moore's Law.

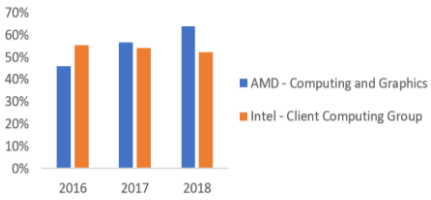
[3] Source: OECD

Due to difficulties observed in recent years by semiconductor companies, in continuing to reduce the size of its chips while reducing costs exponentially, the **Moore's Law has been losing its applicability**. Consequently, the industry is starting to let go of this guide that has been used for the past years. As a matter of fact, **Intel** had been struggling with the production of their **10nm** chips[4], which the market perceives as lack of ability to innovate, making it one of the reasons for Intel's loss of market share in the past couple of years. In this case, **AMD** presents the **advantage** of already being able to produce and commercialize its line of **7nm** products[5].

End Markets and Risk Factors

Since the beginning of the century, "top-of-the-art" technology has had an increasing importance in the world, which made sectors like the semiconductor one to be subject to substantive levels of growth. This is because semiconductors power technologies that enrich the lives of consumers and make businesses and other enterprises run smarter, faster and more efficiently. Still, like most of the tech-related sectors, the semiconductor industry is characterized by a high level of volatility, since the companies that operate in it are largely exposed to changes in consumers' preferences, which have a high impact on the market's demand dynamics. This volatility does not only affect the volumes of sales, but also the average selling prices companies set to attract customers.

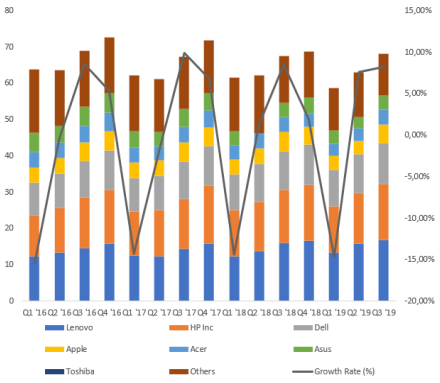
Exhibit 13: PC Related Business Units % of Revenues (Intel vs AMD)



Source: Companies' Annual Reports

Typical customers in this sector are **OEMs**, Original Design Manufacturers (**ODMs**), **large direct datacentres** and **system integrators**, who buy the chips and integrate them in their products to resell it under their brands; and **independent distributors**, who buy the chips and sell them in their original formats directly to consumers and in the form of end-user products like Personal Computers, Smartphones, Video/Console Gaming or other big Data Centre machines that companies like Google, Microsoft, Facebook and Twitter use to manage their services.

Exhibit 14: PC Shipments Worldwide by Vendor from 2016 to 2019 (in million units)



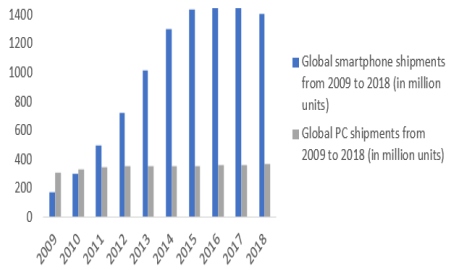
Source: Bloomberg

The Personal Computer market is, up to date, the main sector from where semiconductor companies get their revenues. As an example, **AMD and Intel** have more than **50% of its sales** coming from their PC related business units (**Exhibit 13**). This makes companies like AMD and Intel, the market leaders in the PC chips segment, to be exposed to these segments high level of **seasonality**, since sales are usually low in the first half of the calendar year, recovering a lot in the second half, mainly due to the Christmas holidays. The seasonality can be observed in **Exhibit 14,** where one can see growth rates of about 10% in the 3rd and 4th quarters of each year, compared to negative growth rates in the first half of those years. Therefore, these companies suffer a lot of

[4] Source: Barron's, available at: https://www.barrons.com/articles/intel-stock-chip-delay-1537909750
[5] Source: MIT Technology Review, available at: https://www.technologyreview.com/s/601441/moores-law-is-dead-now-what/

pressure from shareholders to present good results, in terms of earnings, in the first two quarters of the calendar year, which, due to the normal market circumstances, will be lower than in the rest of the year. Good earnings in difficult times can be a sign of core business strength and that the company is able to surpass some of its business dependencies.

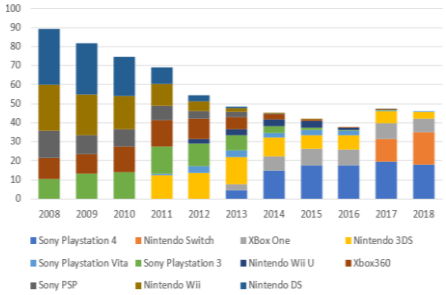
Exhibit 15: PC vs Smartphone Unit Shipments (2009-2018)



Source: Bloomberg

Besides the seasonality of PC sales, these devices, in the later years, have been losing importance to its direct competitors/substitutes, which are the Smartphones. **Unit Shipments** from both devices have been affected from a shift in consumers preferences, where **Smartphone Devices** have been preferred, being the leading devices sold in the technological market. During the period from 2009 to 2018, the Smartphone market grew almost 600% in terms of units shipped, being almost 4 times the ones from the PC market, in 2018 (**Exhibit 15**). With this market trend, there has been a higher focus of Semiconductor companies on the Smartphone market. This shift in consumers preferences have a **direct impact on the way AMD plans its business operations**. Since smartphones carry an added cost of planning, as they **run on smaller size chips**, companies like AMD have to **spend additional resources on R&D**.

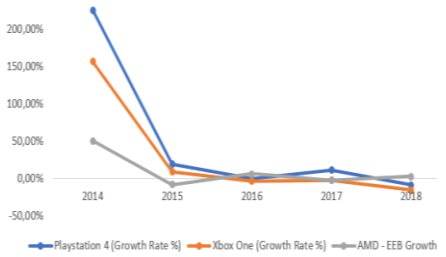
Exhibit 16: Global Unit Sales of Current Generation Video Game Consoles from 2008 to 2018 (in million units)



Source: Statista

When analysing the **Console Video Gaming Market**, one can see that, in big console names like **Sony's PlayStation** console line or **Microsoft's Xbox** console line, there is a tendency, of revenues coming from these products, to increase a lot in its first year of introduction, while decreasing/stabilizing after that (**Exhibit 16**). Looking at the case of Xbox One and PlayStation 4, their growth rates in the first year of introduction were 155% and 220%, respectively (from 2013 to 2014). This makes Semiconductor companies that produce chips to Gaming Consoles, to be, once again, exposed to this market trend, thus presenting a high level of seasonality in its related business units. One evident case is AMD, as its **Enterprise, Embedded and Semi-Custom Business Unit** showed an unusual growth in these products first year of launch (**Exhibit 17**), due to its chips being present in Sony's PlayStation 4 and Microsoft's Xbox One.

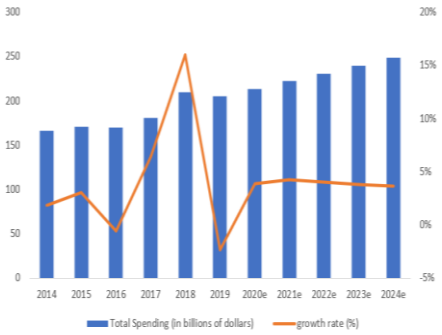
Exhibit 17: PlayStation and Xbox One (Units Sold Growth Rate) vs AMD EEB growth



Source: Statista

Another main market where Semiconductor companies are present is the **Data Centre Market**, which uses superior quality chips, due to its higher performance demand. These centres are present in companies that provide services such as cloud services or open public services like social media and similar Apps. Since these servers are exposed to high usage demand, in today's digital evolving market, they need "top-of-the-art" chips. That is why companies like AMD, Intel, or Broadcom are exposed to a more rigorous demand environment, which obligates them to **spend a lot on R&D** (as stated in the Key Value Drivers section). Data Centres are seen as the future's highest spending business, due to the increased importance of services that comprise a lot of personal information related data (**Exhibit 18**). A market analysis, made by Gartner Research, predicts that companies spending on IT services, related with **Data Centres,** will reach approximately **250 billion dollars until 2024**. This is mostly because the monetization related with these businesses is becoming very high, mainly due to the up-

Exhibit 18: Total Spending (in billion dollars)

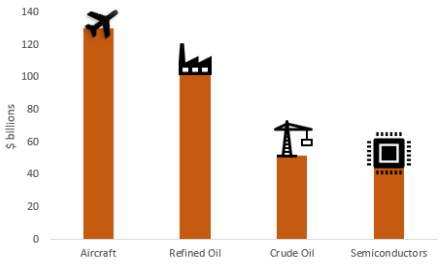


Source: Statista

Exhibit 19: Semiconductor's Value Chain Map

Source: SIA

Exhibit 20: Top 4 U.S. Exports in 2018 (in billion dollars)



Source: SIA

trended online marketing segment, which pays a lot for personal information. Another reason for this market's higher level of monetization is related to the increased importance of cybersecurity. In today's evolving digital market, there are more users and more data crossing the globe, which creates a growing pressure on data centres to facilitate faster data transmissions for an increasing number of Internet users worldwide[6]. With the increased cybersecurity concerns, companies are now facing new challenges to make sure their data stored is protected. Therefore, there has been a recent trend where companies are turning to blockchain, due to its encryption capabilities. For these reasons, companies are increasing their expenditures on larger Data Centres, that work faster and safer.

Besides the difficulties that companies may face in relation to reducing the chips' size and its price, while increasing its performance, added to an industry facing a lot of volatility, some companies in the Semiconductor sector may also face problems at their **supply chains**. In this sector, supply chains are stretched from fabrication plants, where materials are made, to design fabrics, usually located in the U.S. and where its shapes and forms are defined, to back-end factories, where chips are assembled (**Exhibit 19**). These last ones are usually located in Emerging Markets, which, combined with the usual four to six months process of chips manufacturing, can lead to delays in the delivery process. This causes some of the **world's leading OEMs,** like **HP Inc, Lenovo Group Ltd,** and **Dell Technologies Inc**, which are the main customers of semiconductor chipmakers like AMD, to delay the launch of their latest innovations due to lack of chips to incorporate in their products. Also, each fabric has thousands of process steps, which, in turn, have thousands of parameters that can be used in different combinations. With the influence of so many factors, there are a lot of chip failures or defects.[7] Hence, any delays could alienate distributors and end customers, placing a semiconductor company on a bad position and causing even more pressure for it to keep up with production at a faster pace. An example of these possible delays and respective market reaction is the one of Intel's 10nm chips, stated above.

U.S.-China Trade War

According to SIA, Official U.S. Government trade data show that semiconductors are America's fourth largest exporting sector, behind airplanes, refined oil, and crude oil, with a global trade surplus of over $4.5 billion and a trade surplus with China of $2.5 billion, in 2018 (**Exhibit 20**). Thus, with the imminent threat of tariffs, resulting from the U.S.-China Trade War, comprising almost the entire semiconductor supply chain, including its main customers (OEM's), companies like AMD will face an increasing

[6] Source: Deloitte, available at: https://www2.deloitte.com/us/en/pages/consulting/articles/the-future-of-semiconductor-companies-and-iot.html
[7] Source: Rangarajan, B. 2017. McKinsey & Co. available at: https://www.mckinsey.com/industries/semiconductors/our-insights/reimagining-fabs-advanced-analytics-in-semiconductor-manufacturing

pressure on its revenues and costs. This is because semiconductor products have to move around between both countries various times, before they assume their final format and reach to its end customers. When it comes to costs, AMD will see an increase in its Costs of Goods sold due to the increased materials' imports costs. AMD will also face a decrease in its Revenues, because of the inevitable decrease in demand that will come from the higher prices applied on materials, which affects the costs of its main costumers, OEMs.

Another research, conducted by SIA, stated that, imposing tariffs on virtually all Chinese-imported IT products would decrease the U.S. IT market by $70 billion over 2019 and 2020. Prior to this escalating trade conflict, IT spending was forecasted to grow at 5.0% in 2019 and 5.3% in 2020. If the **additional tariffs** are implemented, IT spending growth would drop almost 3 percentage points, down to 2.1% in 2019 and 2.4% in 2020.

Hence, in order to study the possible effects of an escalating trade war between the U.S. and China, a **scenario analysis** was conducted. There are tariffs that are already effective, like the 25% tariff on $250 billion of Chinese goods, and the, recently lowered, 7.5% on $120 billion of Chinese goods (**Exhibit 21**). Therefore, the scenario analysis is based on the effect that other tariffs, which could become effective, can have on AMD's revenues and costs. The one considered as a **threat** is the 15% tariff on $150 billion worth of Chinese goods, which could be the one that completes the effect on all specific parts of the semiconductor supply chain cycle. Still, this one is just a possibility, since most recent data highlighted a pre-agreement between both countries, in the so called "Phase-one deal"[8] where these tariffs were delayed.

The main objective of the analysis is to see the effect coming from the application of U.S. tariffs on Chinese goods. This is because, when it comes to the semiconductor sector, most companies are present in the U.S., as it is the case of AMD. Thus, the effect of the Trade War will be more noticed on the U.S. imports from China, where these companies get most of its material from and have their final product production. Also, most of the tariffs applied by China on U.S. imports are related to agricultural and industrial products like textile and auto parts, which are not directly related to the Semiconductor Sector.

Based on the information stated above, 3 scenarios were considered (**Exhibit 22**), with scenario 1 being the worst-case scenario and scenario 3 being the best possible outcome. The analysis of all scenarios was based on the change of the average rate that could come from each one, and its effect on the company's **costs' increase from imports**, relative to the base case valuation. The decrease in Revenues comes as a reflection of the prediction in IT investment decrease of 3% by SIA (in the worst-case scenario), which is assumed to be coming from less purchases of chips by OEM's, in

Exhibit 21: U.S. Tariffs on Chinese Goods

US Tariffs on Chinese goods	Amount of Goods affected (in US$ billions)	Implementation
25%	250	Effective
7,50%	120	Effective
15%	150	Delayed by Phase One Deal

Source: SIA

Exhibit 22: Trade-War Scenarios

		Average Rate
Scenario 1	All rates become effective and 7.5% rate is, again, increased to 15%	20%
Scenario 2	Phase one deal is finalized and deal is reached with remaining rates	19%
Scenario 3	Phase one deal is finalized and deal is reached with remaining rates and 25% rate reduces to 15%	13%

Source: Model calculations

Exhibit 23: Valuation Scenarios

Scenario	Fair Value	Recommendation
Worst Case	$ 44,02	SELL
Normal Case	$ 52,62	BUY
Best Case	$ 69,17	BUY

Source: Model calculations

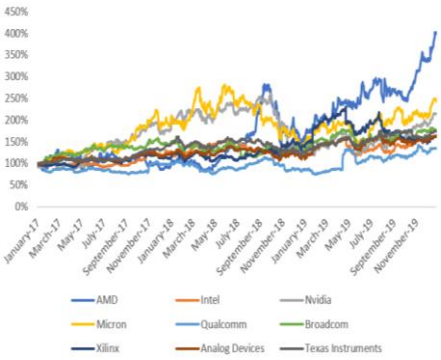
[8] Source: The Guardian, available at: https://www.theguardian.com/business/2019/dec/13/china-confirms-phase-one-trade-deal-us-tariffs

consequence of the decrease in demand from end-customers. These scenarios are the ones considered to be the most likely outcomes from the Trade War negotiations. Both costs and revenues increases/decreases were considered to be dissipating throughout the years. Results of AMD's different valuation scenarios are depicted in **Exhibit 23**, assuming the same WACC and perpetual growth rate as in the main valuation.

From this scenario analysis, it is possible to retrieve that AMD's valuation has a very positive upside coming from the resolution of the Trade War, but still, it can suffer from the aggravation of it. This is shown in the **worst-case scenario**, where the assumptions were that **AMD's revenues would decrease around 8% in 2020**, 3% coming from less IT investment and an additional 5% coming from the increase in the average costs from tariffs. This would hurt its main customers and partners (OEM's), since they would have to increase its prices by 5% and face a decreasing demand, or to incorporate this additional cost and decrease its purchases from AMD by the same 5%. This decrease would dissipate through the years as the costs are transferred to end-customers. Adding to this, AMD would face a **5% cost increase in 2020**, coming from the increase in the average tariffs' value. In the **best-case scenario**, AMD would face a **3% increase in revenues in 2020**, coming from the increased investment in IT, provided by its most direct customers (OEMs). Consequently, AMD would increase its spending due to the higher cash availability coming from the decrease in its costs, due to the lower average tariffs' value. This decrease in costs would also be reflected in AMD's fundamentals, which would see a **32% decrease in its costs in 2020**, related to the variation between the average tariffs' value.

Competitors

Exhibit 24: AMD vs Competitors (Cumulative returns)



Source: Bloomberg

The Semiconductor Industry is characterized by a high level of competition, since it's a sector that comprises a lot of subsegments and where most companies specicialize in a few of them. For example, the **CPU** subsegment (related to the chips incorporated in personal computers, smartphones, notebooks, etc, allowing these devices to normally run their programs), relies mostly on **AMD**, **Intel**, and **Qualcomm,** in terms of production, with this last company not competing anymore in most of the new-generation computers. Another subsegment, the **GPU** (related to the chips responsible for allowing Personal computers, smartphones, etc, to run their graphics and display their images with a better resolution) has its major production coming from **AMD** and **Nvidia**. There are other uses in the market for semiconductor chips, like datacenters, where players like **Broadcom** have a higher focus, from its SoCs products. Furthermore, AMD has to deal with other smaller competitors, which present a very similar size to itself. Among them are **Micron Technology, Inc.**, **Xilinx, Inc.**, **Analog Devices, Inc.** and **Texas Instruments Incorporated**. **AMD** is the **second-largest supplier in the market for x86-based microprocessors,** with its only significant competitor being Intel. Also, since the

acquisition of ATI Technologies Inc., in 2006, AMD has been sharing a duopoly in the **GPU** market with Nvidia. This affirmation in the market has been allowing AMD to constantly give higher returns to market investors than its peers (**Exhibit 24**). This higher performance is not just a matter of investors' sentiment, but has also been a consequence of AMD's gain in market share (mainly to its two most direct competitors, Intel and Nvidia), while being able to increase its products' performance, by its higher investment in R&D. This allowed AMD to compete in the high-end products segment, which made it able to present higher gross margins and improve its fundamentals. All these matters are discussed in more detail in the Key Value Drivers section.

Despite AMD's main competitors being Nvidia and Intel, two of the most iconic and historical players in the Semiconductor Industry, in terms of size and market power, the company still has been able to keep growing and establish itself among them in the market. This can be explained, mainly, by its capacity of price competition, but also by the perseverance that has been shown through the years from its most recent CEO, Lisa Su. In **Exhibit 25**, it is possible to observe AMD's outperformance over its two main competitors, over the last 3 years, with its stock presenting a cumulative return of almost 400%, compared to 163% from Intel and 211% from Nvidia.

Exhibit 25: AMD vs Intel vs Nvidia (Cumulative returns)

Source: Bloomberg

Considering the aforementioned companies, a CAPM regression of each company with the market was performed with daily data, and with a 95% confidence level, to obtain each respective levered beta (3Y Beta). AMD's beta is confidently between 1.80 and 2.38. Moreover, with each Debt-to-Equity ratio and the industry average of unlevered betas, the relevered betas were calculated. The calculation of the beta was based on the Hamada Equation for Levered Beta. As a final result, AMD's Beta considered for the valuation process was **1.50** (**Appendix 4**). By analysing the various companies' unlevered betas, it is possible to conclude that AMD is the company with the highest risk profile among its peers, based on market data and without the impact of debt on its capital structure (without the financial effects of leverage). Still, this is a sector with a high level of systematic risk, which means all companies are subject to risks that cannot be diversified and can hurt their valuations, due to investors' sentiment.

Valuation

Model

The method used to value AMD was the **Discounted Cash Flow (DCF)** with a forecast period of 5 years, between 2019 and 2024. To mitigate the uncertainty inherent to this industry, a 5-year annuity was applied (from 2025 to 2029) growing at a higher rate than the one applied to perpetuity. This rate is the average historical growth rate of the industry (**10.79%**), calculated through the growth rates of revenues of AMD and its

competitors, from 2006 to 2018. The **discount rate (WACC)** and **long-term growth rate** used in the terminal value of the company were, respectively, **9.64%** and **4.09%**.

Working Cash and Adjusted NOPLAT

For the purpose of reorganization and forecast of the financial statements, the cash and cash equivalents were distinguished between working cash and excess cash. The working cash is usually obtained by assessing the minimum cash needed to support the operations of a company, looking for a minimum clustering of cash as percentage of revenues across the industry[9]. Therefore, a sample between 2006 and 2018 was selected with the revenues and cash and cash equivalents of each considered competitor. The two companies with the smallest cash balances, overall, are Intel Corporation and Texas Instruments. These two combined held an average of 11% of cash over total revenues, hence, the benchmarked used to calculate the company's working cash (**Appendix 5**).

Regarding NOPLAT, the one used to determine the free cash flow (FCF) of the core business was adjusted for both operating leases and operating cash taxes. This is because the rental expense embedded in EBIT, related to the leases, contains interest expenses, which leads to an artificially low EBIT if not added back. As well, ignoring the value of operating leases in the balance sheet, results in a low enterprise value, as the they are a part of the company's debt. Thus, in order to compare companies with different leasing strategies, the EBIT (and consequently the NOPLAT) must be adjusted.

Additionally, deferred taxes, that are the most common equity equivalent, occur due to discrepancies in how investors and the government account for taxes. Hence, to avoid this bias, the NOPLAT was adjusted for operating cash taxes (operating taxes plus the change in operating deferred taxes). Because the caption of operating deferred taxes is then incorporated in the adjusted NOPLAT, the account is no longer considered in the calculation of the investment cash flow of the core business, as it would be double counted. Effectively, after applying the mentioned adjustments, the adjusted NOPLAT differs significantly from the usual NOPLAT, by an absolute average of approximately 70 million dollars. (Operating Cash Taxes and Operating leases are shown in **Appendix 6**).

Forecast

Partnerships

With the release of the **2nd Gen AMD EPYC processors ("Rome")**, AMD was able to bring a record-setting performance, providing 200% of the performance of the

[9] Source: Valuation- Measuring and Managing the Value of Companies fifth edition (Mckinsey & Company)

previous EPYC generation, while offering an expected 25% to 50% lower total cost of ownership among other competitive products. This means AMD's customers/partners will spend less on its equipment maintenance during its useful lifetime. Because of this, numerous partnerships arose, intending to use 2nd Gen AMD EPYC processors, not only involving usual clients of the company but also attracting new ones. Among other announcements:

- Google announced the use of the processors in its internal infrastructure and also machines powered by them on Google Cloud Compute Engine (end of 2019/beginning of 2020);
- Twitter announced it will use the processors across its data centre infrastructure and that will enable the company to reduce the total cost of ownership (TCO)[10] by 25%, while still lowering the ecological footprint (energy consumption) of its data centres (end of 2019/beginning of 2020);
- UK Research and Innovation (UKRI) announced that Cray will supply the hardware for the next supercomputer, ARCHER2, powered by 2nd Gen AMD EPYC processors (mid 2020). Cray's Shasta supercomputer is expected to be the UK's most powerful supercomputer and will drive research across various fields of study. As well, Cray's Shasta system with 2nd Gen AMD EPYC processors will provide terrestrial and space weather information to the U.S. Air Force and Army;
- ATOS, a French information technology company, announced that Genci was also using the 2nd Gen AMD EPYC processors to develop a supercomputer (BullSequana) for the assistance of French scientific communities. The BullSequana (2019) has surpassed prior records, using both AMD and non-AMD processors, regarding the benchmarks of the Standard Performance Evaluation Corporation (SPEC);
- Dell Technologies, HPE and Lenovo, some of the company's historical customers, announced several new server platforms using EPYC processors (end of 2019/beginning of 2020);
- Nokia and IBM Cloud listed the performance improvements of 2nd Gen AMD EPYC processors for both their cloud and 5G customers, comprising cloud security enhancements and better memory for big data and analytics workloads, among others (end of 2019/beginning of 2020).

Besides the EPYC processors, that were key products to new collaborations, AMD also launched, during 2019, the **3rd Generation Ryzen Family (ZEN 2)** processors, the ***Athlon* PRO *Processors*** with Radeon Vega Graphics, the **Radeon RX 5700 Series** and the **Radeon RX 5500 Series** Graphics (Navi family). Therefore, more alliances arose involving these products:

[10] Total Cost of Ownership: total cost to own and operate a piece of equipment over its useful life (Source: Keysight Technologies).

- Microsoft revealed that its new Microsoft Surface Laptop 3 will have incorporated both AMD Radeon Vega Graphics and AMD Ryzen mobile processor (end of 2019/beginning of 2020). Additionally, Microsoft plans to launch the new Xbox 2 (Project Scarlett) by the end of 2020. The new Xbox will have incorporated AMD's Zen 2 and Radeon RDNA architecture, and the company ensures it will be four times more powerful than the Xbox One X;
- Again, HP and Lenovo stated they will use AMD Ryzen PRO 3000 Series and AMD Ryzen PRO processors with Radeon Vega Graphics in their new desktop business PCs. Among these is the first AMD-powered gaming laptop, offered by HP, the Pavilion Gaming 15 Laptop (end of 2019/beginning of 2020);
- AIB partners including Sapphire, MSI, Asus, PowerColor, Gigabyte and XFX released new graphics cards with Radeon™ RX 5700 series graphics (end of 2019/beginning of 2020);
- Google also chose AMD Radeon datacentre GPUs for its Vulkan and Linux-based Google Stadia, cloud gaming service (end of 2019/beginning of 2020);
- Sony is also launching its new PlayStation 5 (PS5) by the end of 2020. The PS5 will use an 8-core AMD chipset based on the 3rd generation Ryzen architecture, with a Radeon Navi GPU;
- AMD is also developing another supercomputer alongside Cray, the Frontier, which is expected to be the world's fastest computer ever built. AMD is contributing also with the incorporation of its Radeon Instinct chips, which are expected to compete directly, in the machine learning market, with Nvidia's chips used by Tesla. This project is to be used by the US Government's Department of Energy, expecting that, by it solving calculations 50 times faster than the top supercomputers of the present, the Frontier will support researchers in fields such as energy assurance, economic competitiveness, weather, and national security (2021).

Moreover, it is important to mention that the price-performance competitive advantage mentioned before, regarding the EPYC processors is also applicable to other products, especially the Ryzen ones, as they present consistently a **CPU value** (CPU Mark/price) higher when compared to Intel[11].

During the month of December 2019, AMD announced it was stretching its partnerships into other sectors like Blockchain technology, where it **joined Blockchain Game Alliance (BGA)** and forged partnerships with leading technology providers to help promote the development and proliferation of new blockchain-powered gaming platforms. AMD announced **partnerships** with **Robot Cache**, which launched their online gaming marketplace in June, and **ULTRA**, which plans to launch its online gaming marketplace in the coming months.

[11] Source: CPU Benchmark, available at: https://www.cpubenchmark.net/cpu_value_available.html

Key Value Drivers

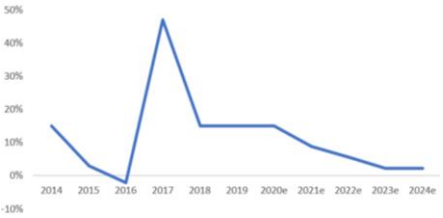
Computing and Graphics Business Unit

For **AMD's value** derivation, there were considered various factors, among which are **Revenues, Gross Margin, R&D Spending and Market Share**. Revenues were itself derived from two main drivers, which are the **Average Selling Price (ASP)** and **Unit Shipments**. These two business drivers are considered to be fundamental for a company's competitive advantage in the market. In terms of ASPs, AMD has established itself throughout the years, as a company who wants to compete via lower price ranges, while keeping up with high **performance** products. When looking at one of AMD's most recent presentations on its EPYC products' line, **Exhibit 26**, which is based on a study by an independent entity called SPEC, one can see that, in the lower price range products, AMD's products present a performance of about 56% higher compared to the ones from Intel. The difference decreases as the price range gets higher, but AMD continues to have a better performance, of about 15%. As a result, this is expected to stay the same, at least for the next years, being an assumption of the present valuation model.

Exhibit 26: Performance per Price Range

Source: AMD's Website

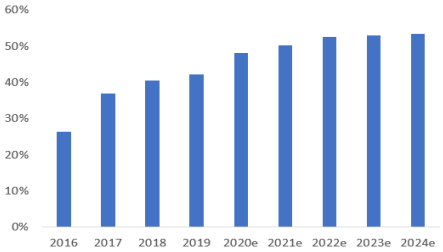
Exhibit 27: AMD – ASP Evolution



Source: AMD's Annual Reports and Forecast

In the later 3 to 4 years, AMD has been able to **gain Market Share** to its competitors, mainly Intel, which has been controlling the market for years. This allows AMD to start betting on higher prices, as its brand recognition has been increasing, thus giving it more market power and influence. Hence, it is predicted that AMD will continue to raise prices at its later years average increase, starting to slowly decrease this rate yearly, so that it is able to keep its prices below the ones from Intel, while gaining a higher margin on its products (**Exhibit 27**). Additionally, it is predicted, not only by this model but also by a management's announcement, that AMD's products' gross margin will increase to the +50% range (**Exhibit 28**), as some of the company's latest launched products are already being priced to achieve greater margins. A higher Gross Margin is expected to give AMD better earnings in the future, therefore increasing its value.

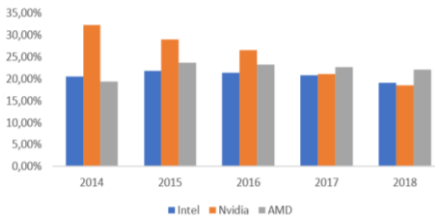
Exhibit 28: AMD – Gross Margin (%)



Source: AMD's Annual Reports and Forecast

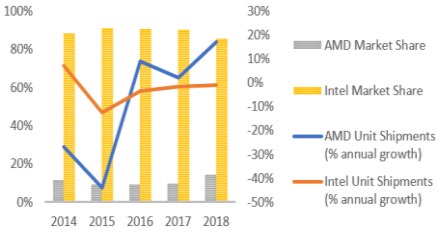
The Semiconductor sector is characterized by its necessity of continuous innovation and being able to keep up with its end-markets' demand evolution. For that, companies spend a big part of their revenues in **R&D**, thus, this is seen as a Key Value Driver of the company. AMD, when compared to its two most direct competitors, Intel and Nvidia, has been spending more of its Revenues in R&D, since 2017. This is seen as a driver of the company's differentiation in the market, giving it a competitive advantage in terms of innovation. By looking at the clients AMD has been able to gather throughout the years, in terms of OEMs, there is a clear relation with the results from the increased spending on innovation. Then, it is predicted that AMD will keep up with its percentage of **costs related to R&D** in the 22% tier, since this is a level that is already above its competitors (**Exhibit 29**).

Exhibit 29: AMD – R&D Spending (% of revenues)



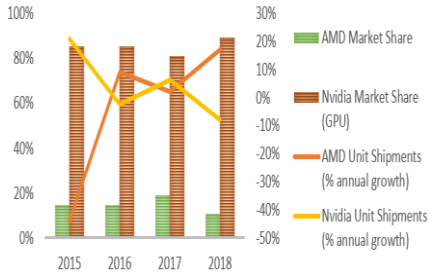
Source: Each Company's Annual Reports

Exhibit 30: MPU Market



Source: Bloomberg

Exhibit 31: GPU Market



Source: Bloomberg

Another driver of revenues considered was the growth in the units shipped by the company throughout the years. Due to market conditions that were approached above (lower PC sales, for example), semiconductor companies have been struggling with the growth of its units shipped, with Intel, for example, facing a decrease every year (for the past 4 years). As presented in **Exhibit 30 and 31**, AMD has been able to show an increasing growth in its Unit Shipments, since 2016, against Nvidia and Intel, growing at an average of 9% against -1.2% and -2%, respectively. This is believed to be a cause for its increasing market share, especially in the MPU market (a subsegment of the Server Market). During many years, this market was ruled by Intel in a monopoly type of way, and in 2018, AMD was able to reach a share of 14.3% (y-axis of exhibit 30). Therefore, it is predicted that AMD keeps its competitive advantage, being able to deploy more of its products during the next few years. For the long run, the prediction is more conservative, due to the competitive environment the company faces and the volatile markets it operates in. The increase in unit shipments was predicted as the average of its competitors that present more mature fundamentals and signs of market power. From the growth rates of ASP and Unit Shipments, it is possible to predict Revenues growth rate, based on the mathematical relation:

II. Revenues Growth Rate = ASP Growth Rate + Unit Shipments Growth Rate + (ASP Growth Rate * Units Shipments Growth Rate)

Enterprise, Embedded and Semi-Custom Business Unit

For this Business Unit, the prediction model of Revenues is made through a different approach, since ASPs are not displayed nor directly available to outside investors and consumers. In this business unit, the products are mainly the ones that are incorporated in Gaming Consoles or used for Data Centre purposes. Thus, revenue prediction is expected to follow the later years' trends. For 2020, it is expected that revenues will grow 55%[12], as it will be the year where most of the gaming consoles, where AMD is present, will be launched (PlayStation 5, Xbox One X and Google Stadia). The high level of growth follows the path that happened with this sector the last time new consoles were launched (case of PlayStation 4 and Xbox One from 2013 to 2014).

Financials

AMD finances itself through various types of debt. The ones in force are the **7.50% Senior Notes**, due 2022, issued in 2012 with a principal amount of 500 million dollars and counting now with an outstanding aggregate principal amount of 312 million dollars; the **7.00% Senior Notes**, due 2024, issued in 2014 with a principal amount of 500 million

[12] Source: Group prediction due to past analysis

dollars and holding now an outstanding aggregate principal amount of 96 million dollars; the **2.125% Convertible Senior Notes**, due 2026, issued in 2016 with a principal amount of 805 million and counting now with a value of approximately 251 million dollars; and a **Secured Revolving Facility**, that the company entered into, in the middle of 2019. The agreement involves a five-year secured revolving loan facility, up to 500 million dollars, comprising a 50 million-dollar swingline subfacility and a 75 million-dollar sublimit for letters of credit. The collateral of the credit agreement is a lien over AMD's property, excluding intellectual property. The interest borne on these borrowings depends on a variable rate based, either at the LIBOR rate, or a base rate defined, plus an applicable margin. The latter can range from 1.00% to 1.75% per annum, concerning the LIBOR rate loans, or from 0.00% to 0.75%, for base rate loans. In 2019, under the credit agreement, AMD had 14 million dollars of letters of credit outstanding.

Besides this, the **capitalized operating leases**, that are an off-balance sheet debt, should also be taken into account. Therefore, as the company presented in its annual report the rent expenses, the weighted-average discount rate (k_d = 6.12%) and the weighted-average remaining lease term (*Asset Life* = 7 years), the Lease Value could be obtained through the application of the following formula (McKinsey Valuation Book):

III. $$Lease\ Value_{t-1} = \frac{Rental\ Expense_t}{k_d + \frac{1}{Asset\ Life}}$$

In terms of forecast, the company also provides the future payment obligations related to rent expenses until 2024, thus, following the assumption that AMD will not contract additional operating leases until that date, the same formula was applied to calculate the future value of the capitalized operating leases. Regarding the secured revolving facility, it was assumed that the company will remain with a constant value of 14 million dollars of letters of credit outstanding until 2024. Moreover, for the 7.50% and 7.00% Senior Notes, **it was assumed the company would reissue new debt with the same initial principal amount after the end of each maturity**, in this case, 2022 and 2024, respectively. Finally, the convertible debt was divided into debt and equity component. The debt component was computed by summing the present value of coupons, being them semi-annual, and the present value of the principal amount. The equity component was calculated as the difference between the principal amount and the debt component, giving the values presented in **Appendix 7**.

Cost of Capital (WACC)

The calculation of the WACC, **Exhibit 32**, was based on the assessment of the company's cost of equity and cost of debt. In relation to the **Cost of Equity (9.66%)**, the approach used for its calculation was the CAPM, with the Risk-free Rate considered being the **10Y Government Bond Yield (1.92%)**, the Beta being the one computed

Exhibit 32: WACC Calculation

(In millions)	
WACC	**9,64%**
Market value of equity	51 071
Convertible (Equity Component)	77
Book value of debt	422
Convertible (Debt Component)	175
Value of operating leases	235
Excess Cash	731
Market value of debt (net)	101
Total (EV)	51 249
Tax Rate	21%

Source: Valuation Model

above in the Competitors Section, and the **Market Risk Premium (5.16%)** being calculated based on a forward-looking estimation method. This method, which was **cited by Aswath Damodaran**[13], is based on the idea of the high standard errors that come attached to historical risk-premiums alongside the survivorship bias that leads to a sampling error. This method is based on projected **Dividends and Buybacks**, which are expected to increase, over the next 5 years, at the **Compounded Annual growth rate of earnings (4.85%),** presented in the past 5 years. These are an approximation of an investor's average actual expected cash flows from the market and are discounted at the **Implied Expected Market Return (10.59%)**. The Market Risk Premium is then the difference between the Implied Expected Return on the Market and the Historical Average Risk-Free Rate (**Appendix 8**). It is also important to mention that the Risk-Free Rate chosen was the 10Y Government Bond Yield, as the maturity of debt contracted by AMD is usually 10 years.

For the **Cost of Debt**, it was used an estimated Yield Spread over U.S. treasuries by bond rating, based on the **USD US Technology BB- BVAL Index**[14]**.** AMD has a Credit Rating of **BB-** (S&P) or **Ba2** (Moody's), corresponding to a Yield Spread of 2.60%. As a result, the Implied **Cost of Debt** is **4.52%**, the sum of the Yield Spread and the Risk-free Rate. The current yield of AMD's longest maturity notes is 7% (from 2014 to 2024).

Concluding, the **Weighted-Average Cost of Capital**, taking into account the **Debt-to-Equity Ratio (0.20%)** and the Tax Rate (21%), assumes a value of **9.64%**.

ROIC and Economic Profit

The choice of analysing ROIC instead of ROCE is because, the last one is a preferred measure of performance in capital intensive companies, that do a lot of Capex investments. This is not the case of AMD, since it invests most of its money in R&D and Intellectual Property (IP). Also, by looking at ROIC it is possible to analyse the efficiency of the company in taking returns from its capital in circulation (invested), thus being a better measure of comparison to the WACC (a measure of expected return to shareholders). So, to see AMD's performance in terms of profitability, an analysis of its ROIC was conducted, to assess if AMD is using its Invested Capital in an effective way to generate returns (creating value), as this is considered to be the amount of return a company makes above the average cost it pays for its debt and equity capital. When comparing the **ROIC** and **WACC** values (**22.85% vs 9.64%**, respectively), in **Appendix 9**, it is possible to conclude that AMD is being able to **create value** to its shareholders **through its invested capital**.

[13] Source: Damodaran, A. 2019, available at: https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3378246
[14] Source: Bloomberg

Still, AMD is in a sector that requires little capital-intensity, thus, leading to low levels of Invested Capital. AMD itself runs its business based on outsourcing the assembly of the chips it designs, arranging IP licences, and guaranteeing strategic alliances/partnerships, causing it to have a reduced need for capital intensive investments in fixed assets, like machinery or property. For this reason, its ROIC values are always very high or very low, which makes it a complicated ratio to compare to WACC and use it as a measure of the company's performance.

Thus, a better approach to the company's value creation performance is to compare its annual Economic Profit, as a % of Revenues, with its WACC[15]. With this, it is possible to analyse the opportunity cost the company incurs when using its cash to invest in the business, instead of distributing it to shareholders. Also, this ratio is better to evaluate the relative financial performance of businesses with different capital-investment strategies and to make sound judgments about where and how to spend investment dollars.

From **Exhibit 33** it is possible to conclude that, during the valuation period, **AMD** will be able to **create value** from 2021 onwards, since its Economic Profit, as a % of Revenues, is greater than the WACC, making it a **good investment target**.

Exhibit 33: Economic Profit (% of revenues)

Return Ratios	2014	2015	2016	2017	2018	2019	2020e	2021e	2022e	2023e	2024e
Economic Profit	-367,85	-425,25	-457,73	437,65	194,27	276,31	837,07	1 421,68	1 883,22	2 345,73	2 774,74
as % of Revenue	-6,68%	-10,66%	-10,60%	8,33%	3,00%	4%	7,66%	11,29%	13,59%	16,09%	18,08%

Source: Valuation Model

Cash Conversion Cycle

Exhibit 34: Cash Conversion Cycle (in days)

Source: Each Company's Annual Reports

To evaluate AMD's **ability to generate cash from its production and investments in inventory**, an analysis to the company's Cash Conversion Cycle (CCC) was conducted. There were used three Balance Sheet ratios of the company: the Days Sales of Inventories (DSI - days that the company takes to sell its inventory); the Days Sales Outstanding (DSO – days that the company takes to receive cash from sales); and the Days Payables Outstanding (DPO – days that the company takes to pay to its suppliers).

When looking at **Exhibit 34**, it is possible to see that **AMD** has been able to present a below average CCC ratio, since 2016, which reflects the company's improvement in terms of efficiency and effectiveness of its operations. Extending the analysis in comparative terms, AMD, against its two main competitors, Intel and Nvidia, it is possible to see the trend that has been hitting this sector, which is the increasing number of days these companies take to deploy their existing inventory. By looking at **Exhibit 34**, one can see that the **average number of days these companies take to turn its**

[15] Source: Dodd, M. and Rehm, W. 2005. McKinsey, available at: https://www.mckinsey.com/business-functions/strategy-and-corporate-finance/our-insights/comparing-performance-when-invested-capital-is-low

inventories into sales has been increasing exponentially through the years (63% between 2014 and 2018). By looking at the most extreme case, Nvidia's one, its DSI went from 38 days in 2014 to 126 days in 2018, which caused its CCC ratio to surpass Intel and AMD by a large amount (130 days vs 100 days and 80 days, respectively).

This trend has been **hurting** all of them, in terms of **efficiency** and **effectiveness** of cash generation, since their individual cash conversion cycle ratio has also been increasing. This allows for the conclusion that the market might be suffering from oversupply, which corroborates the also observed trend of **decreasing ASP's** stated above. According to KeyBanc Capital Markets[16], a big reason for this trend was the **U.S.-China Trade War tensions**, which led to a **weak demand at the supply-chain level**, limiting companies from shipping additional products into the channel.

Comparables Valuation

To assess AMD's value from a different valuation perspective, a **Relative valuation method** was conducted based on market multiples of the company's comparables and itself. The comparables were considered to be the same as the ones used in the DCF valuation, except for Broadcom, Inc. and Qualcomm, Inc., due to its differences in terms of dimensional size of operations and main sources of revenues, in comparison with AMD. The multiples considered in this valuation were the **EV/EBITDA** (TTM- Trailing Twelve Months), **P/E Ratio** (TTM), and **P/Sales** (TTM). When looking at all P/E ratios, it is possible to conclude that the market is overvaluing AMD, which shows a very positive investors' sentiment towards the stock and its value (**Appendix 10**).

The average value of each multiple was applied to AMD's line items considered, EBITDA, Earnings per share, and Sales, to find what are the different fair values AMD should present in relation to its comparables' multiples. The fair value of AMD, based on this valuation method is then, $29.15 per share from the EV/EBITDA Multiple, $20.41 per share from the P/E Ratio Multiple, and $72.34 per share from the P/Sales Multiple.

As these values are very dispersed, a multiples valuation is believed to not have the informational effect needed to conclude on AMD's fair value. For this reason, it is believed that the value of AMD can be better assessed through the DCF model described above.

Conclusions and Recommendation

As of 31st December 2020, the share price of AMD, according to the forecast already described, is predicted to be around **$52.75**. This value was calculated by

[16] Source: Investor's Business Daily, available at: https://www.investors.com/news/technology/semiconductor-industry-facing-elevated-chip-inventories/

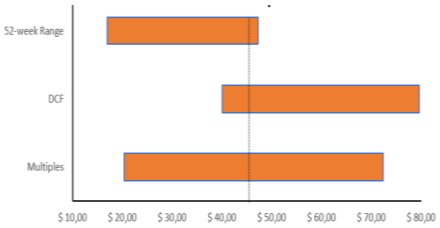
subtracting the Net Debt and adding the Equity component of the Convertible Notes, from the Total Value and then dividing it by the total outstanding shares of the company. The total number of shares outstanding in 2020 is predicted to be lower than in 2019, as a result of the predicted net transactions with shareholders, which reflect the occurrence of share buybacks. These buybacks are done in a small percentage, assuming that the reasons for them to happen are in accordance with the signalling theory, which predicts these buybacks are a signal from management that it has favourable new inside information about the company's future prospects. Another prediction of various empirical theories is that companies, who enter in buyback programs, often see their market stock price to be undervalued, which, in the case of these report, corroborates the higher price estimated. For these reasons, the number of shares considered for 2020 is approximately **1111 million** (instead of 1114). The variation of the shares outstanding, over the years, is depicted in **Appendix 11**.

The Total Value of the company represents the sum of the present values of all cash flows of the core business, the 5-year annuity value described above, the terminal value from 2029 onwards (using the estimated WACC and Long-term Growth Rate), and the value of the total invested capital of the non-core business (2020). The Net Debt represents the sum of all debt in 2020 minus the Excess Cash.

As the stock price, at **31st December 2019**, assumed a value of **$45.86**, it is possible to conclude an estimated **expected shareholder's return of 15.03%**, as the company does not pay dividends and assuming small capital gains coming from buybacks. Consequently, the investment recommendation is a **BUY**, as the expected total return is higher than 10%.

In **Exhibit 35**, it can be observed the amount of upside to shareholders that is coming from AMD's different valuation methods.

Exhibit 35: AMD's Price Fluctuation



Source: Calculations made with data from each company's annual reports and Bloomberg data

Sensitivity Analysis

Because the WACC and Long-term Growth Rate are inputs that have a strong impact on a company's valuation, a sensitivity analysis was performed, setting a confidence interval of 0.5% for both parameters. The **changes in WACC** are expected to come from possible financing programs launched by the company. These could alter its **cost debt**, if the company is increasing its debt financing, thus changing its corporate debt rate and respective spread. It also can change its **cost of equity**, if the company issues more shares, creating dilution. The **changes in the growth rate** are expected to come from **strong economic years** for the two countries considered (U.S. and China), leading them to present GDP levels **above the markets' analysts and institutions expectations**. From this, a price range varying from **$40.00 to $79.62** was derived, highlighting the sensitivity of the price to changes in these inputs. However, the vast majority of values would still determine a **BUY** recommendation.

Exhibit 36: Sensitivity Analysis- WACC vs Growth Rate

Share Price		Growth Rate				
		3,09%	3,59%	4,09%	4,59%	5,09%
WACC	8,64%	$ 56,29	$ 60,39	$ 65,39	$ 71,63	$ 79,62
	9,14%	$ 51,19	$ 54,49	$ 58,44	$ 63,26	$ 69,27
	9,64%	$ 46,88	$ 49,57	$ 52,75	$ 56,56	$ 61,21
	10,14%	$ 43,19	$ 45,42	$ 48,02	$ 51,08	$ 54,76
	10,64%	$ 40,00	$ 41,86	$ 44,01	$ 46,52	$ 49,48

Source: Valuation Model

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Appendix

Appendix 1- Income Statement Forecast (in million $)

Operational Income Statements (Core)	2014	2015	2016	2017	2018	2019	2020e	2021e	2022e	2023e	2024e
Net revenue	$ 5 506	$ 3 991	$ 4 319	$ 5 253	$ 6 475	$ 7 733	$ 10 933	$ 12 590	$ 13 856	$ 14 580	$ 15 348
Computing & Graphics	$ 3 132	$ 1 805	$ 1 988	$ 2 977	$ 4 125	$ 5 147	$ 6 925	$ 8 180	$ 9 004	$ 9 304	$ 9 613
Enterprise, Embedded and Semi-Custom	$ 2 374	$ 2 186	$ 2 331	$ 2 276	$ 2 350	$ 2 586	$ 4 008	$ 4 410	$ 4 852	$ 5 276	$ 5 734
Cost of sales excluding D&A	$ 3 464	$ 2 744	$ 3 183	$ 3 322	$ 3 858	$ 4 485	$ 5 685	$ 6 273	$ 6 588	$ 6 878	$ 7 183
Gross Margin	**$ 2 042**	**$ 1 247**	**$ 1 136**	**$ 1 931**	**$ 2 617**	**$ 3 248**	**$ 5 248**	**$ 6 317**	**$ 7 267**	**$ 7 702**	**$ 8 165**
Research and development	$ 1 072	$ 947	$ 1 008	$ 1 196	$ 1 434	$ 1 724	$ 2 437	$ 2 806	$ 3 088	$ 3 012	$ 2 883
Marketing, general and administrative	$ 563	$ 449	$ 439	$ 485	$ 525	$ 673	$ 951	$ 1 095	$ 1 205	$ 1 268	$ 1 335
Licensing gain	$ -	$ -	$ (88)	$ (52)	$ -	$ (60)	$ -	$ -	$ -	$ -	$ -
Goodwill impairment charge	$ 233	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
EBITDA	**$ 174**	**$ (149)**	**$ (223)**	**$ 302**	**$ 658**	**$ 912**	**$ 1 860**	**$ 2 416**	**$ 2 974**	**$ 3 421**	**$ 3 947**
Lease Depreciation	$ 41	$ 33	$ 27	$ 31	$ 37	$ 38	$ 34	$ 30	$ 28	$ 25	$ 71
Depreciation & Amortization Expense (included in COGS)	$ 203	$ 167	$ 133	$ 144	$ 170	$ 257	$ 363	$ 418	$ 460	$ 484	$ 510
Amortization of acquired intangible assets	$ 14	$ 3	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
EBIT	**$ (84)**	**$ (352)**	**$ (383)**	**$ 127**	**$ 451**	**$ 617**	**$ 1 463**	**$ 1 968**	**$ 2 486**	**$ 2 913**	**$ 3 366**
Implicit Interest on Operating Leases	$ (18)	$ (14)	$ (12)	$ (13)	$ (16)	$ (16)	$ (14)	$ (13)	$ (12)	$ (10)	$ (31)
Adjusted EBIT	**$ (66)**	**$ (338)**	**$ (371)**	**$ 140**	**$ 467**	**$ 633**	**$ 1 478**	**$ 1 980**	**$ 2 498**	**$ 2 923**	**$ 3 397**
Operating Taxes	$ (22)	$ (109)	$ (132)	$ (403)	$ 101	$ 135	$ 311	$ 416	$ 525	$ 614	$ 713
Operating cash taxes	$ 84	$ (56)	$ (5)	$ (427)	$ 65	$ 155	$ 422	$ 320	$ 344	$ 278	$ 312
NOPLAT	$ (44)	$ (229)	$ (239)	$ 543	$ 366	$ 498	$ 1 166	$ 1 564	$ 1 973	$ 2 309	$ 2 684
NOPLAT (adjusted for operating cash taxes and operating leases)	$ (150)	$ (282)	$ (366)	$ 567	$ 402	$ 478	$ 1 055	$ 1 661	$ 2 154	$ 2 646	$ 3 084

Financials	2014	2015	2016	2017	2018	2019	2020e	2021e	2022e	2023e	2024e
Interest expense	$ (177)	$ (160)	$ (156)	$ (126)	$ (121)	$ (19)	$ (19)	$ (33)	$ (27)	$ (32)	$ (45)
Tax Shield	$ (61)	$ (56)	$ (55)	$ 362	$ (26)	$ (4)	$ (4)	$ (7)	$ (6)	$ (7)	$ (9)
Implicit Interest on Operating Leases	$ (18)	$ (14)	$ (12)	$ (13)	$ (16)	$ (16)	$ (14)	$ (13)	$ (12)	$ (10)	$ (31)
Tax shield on Operating Leases Interest Expenses	$ (6)	$ (5)	$ (4)	$ 38	$ (3)	$ 135	$ 311	$ 416	$ 525	$ 614	$ 713
Equity loss in investee	$ -	$ -	$ (10)	$ (7)	$ (2)	$ -	$ -	$ -	$ -	$ -	$ -
Financial Result	$ (127)	$ (113)	$ (118)	$ (546)	$ (110)	$ (166)	$ (341)	$ (455)	$ (558)	$ (649)	$ (779)

Non Core	2014	2015	2016	2017	2018	2019	2020e	2021e	2022e	2023e	2024e
Other income (expense), net	$ (66)	$ (5)	$ 80	$ (9)	$ -	$ 18	$ 21	$ 17	$ 19	$ 19	$ 19
Restructuring and other special charges, net	$ (71)	$ (129)	$ 10	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Taxes on non-core business	$ (48)	$ (47)	$ 32	$ 26	$ -	$ 3,77	$ 4,32	$ 3,57	$ 3,87	$ 3,93	$ 3,99
Nonoperating tax adjustments	$ 142	$ 230	$ 199	$ (5)	$ (81)	$ 94	$ 94	$ 94	$ 94	$ 94	$ 94
Taxes on non-core business (Adjusted)	$ 94	$ 183	$ 231	$ 21	$ (81)	$ 98	$ 99	$ 98	$ 98	$ 98	$ 98
Other Comprehensive Income	$ (3)	$ (3)	$ 3	$ 11	$ (14)	$ -	$ -	$ -	$ -	$ -	$ -
Unrealized gains (losses) on available-for-sale securities	$ -	$ (2)	$ -	$ 1	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Unrealized gains (losses) on cash flow hedges	$ (3)	$ (1)	$ 3	$ 10	$ (14)	$ -	$ -	$ -	$ -	$ -	$ -
Cumulative-effect adjustment to accumulated deficit	$ -	$ -	$ -	$ -	$ 2	$ -	$ -	$ -	$ -	$ -	$ -
Non-core Result	$ (234)	$ (320)	$ (138)	$ (19)	$ 69	$ (80)	$ (78)	$ (81)	$ (80)	$ (80)	$ (79)
Comprehensive Income	$ (406)	$ (663)	$ (495)	$ (22)	$ 325	$ 253	$ 748	$ 1 028	$ 1 335	$ 1 581	$ 1 826

Appendix 2- Balance Sheet Forecast (in million $)

Operating Assets (OA)	2014	2015	2016	2017	2018	2019	2020e	2021e	2022e	2023e	2024e
Working Cash	$ 611	$ 443	$ 479	$ 583	$ 719	$ 858	$ 1 214	$ 1 398	$ 1 538	$ 1 618	$ 1 704
Accounts receivable, net	$ 818	$ 533	$ 311	$ 454	$ 1 235	$ 1 271	$ 1 450	$ 1 670	$ 1 837	$ 1 462	$ 1 539
Inventories, net	$ 685	$ 678	$ 751	$ 694	$ 845	$ 995	$ 1 124	$ 1 240	$ 1 421	$ 1 484	$ 1 550
Prepayment and receivables - related parties	$ 113	$ 33	$ 32	$ 33	$ 52	$ 17	$ 96	$ 111	$ 122	$ 128	$ 135
Prepaid expenses	$ 32	$ 43	$ 63	$ 77	$ 57	$ 84	$ 119	$ 138	$ 151	$ 159	$ 168
Property and equipment, net	$ 302	$ 188	$ 164	$ 261	$ 348	$ 376	$ 532	$ 613	$ 674	$ 710	$ 747
Goodwill	$ 320	$ 278	$ 289	$ 289	$ 289	$ 289	$ 289	$ 289	$ 289	$ 289	$ 289
Software and technology licenses, net	$ 219	$ 189	$ 234	$ 239	$ 226	$ 226	$ 226	$ 226	$ 226	$ 226	$ 226
Capitalized Operating Leases	$ 230	$ 191	$ 216	$ 260	$ 265	$ 235	$ 211	$ 196	$ 172	$ 500	$ 500
Operating deferred-tax assets	$ -	$ -	$ 40	$ 16	$ -	$ 0	$ 111	$ 15	$ -	$ -	$ -
Total operating assets	$ 3 331	$ 2 576	$ 2 579	$ 2 906	$ 4 035	$ 4 353	$ 5 373	$ 5 894	$ 6 431	$ 6 577	$ 6 857

Operating Liabilities (OL)	2014	2015	2016	2017	2018	2019	2020e	2021e	2022e	2023e	2024e
Accounts payable	$ 415	$ 279	$ 440	$ 384	$ 528	$ 811	$ 1 028	$ 1 134	$ 1 191	$ 907	$ 947
Payables to related parties	$ 218	$ 245	$ 383	$ 412	$ 533	$ 480	$ 608	$ 671	$ 705	$ 736	$ 768
Accrued liabilities	$ 502	$ 426	$ 391	$ 555	$ 763	$ 792	$ 1 119	$ 1 289	$ 1 419	$ 1 493	$ 1 571
Deferred income on shipments to distributors	$ 72	$ 53	$ 63	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Unearned revenue	$ -	$ -	$ -	$ 85	$ 11	$ 28	$ 39	$ 45	$ 50	$ 52	$ 55
Other long-term liabilities	$ 105	$ 86	$ 113	$ 107	$ 181	$ 178	$ 252	$ 290	$ 319	$ 336	$ 353
Operating deferred-tax liabilities	$ 140	$ 87	$ -	$ -	$ 20	$ -	$ -	$ -	$ 166	$ 502	$ 902
Total operating liabilities	$ 1 452	$ 1 176	$ 1 390	$ 1 543	$ 2 036	$ 2 288	$ 3 046	$ 3 429	$ 3 849	$ 4 025	$ 4 597

Net Operating Assets - Invested Capital Core Business	$ 1 879	$ 1 400	$ 1 189	$ 1 363	$ 1 999	$ 2 065	$ 2 326	$ 2 465	$ 2 582	$ 2 552	$ 2 260

Invested Capital Non-Core Business	2014	2015	2016	2017	2018	2019	2020e	2021e	2022e	2023e	2024e
Nonoperating deferred-tax assets (liabilities)	$ 159	$ 97	$ (40)	$ (16)	$ 24	$ 45	$ 45	$ 45	$ 45	$ 45	$ 45
Marketable securities	$ 235	$ -	$ -	$ -	$ 78	$ 53	$ 61	$ 32	$ 37	$ 44	$ 51
Other current assets	$ 46	$ 240	$ 109	$ 191	$ 195	$ 156	$ 178	$ 166	$ 177	$ 175	$ 170
Investment: equity method	$ 65	$ -	$ 59	$ 58	$ 58	$ 48	$ 45	$ 54	$ 52	$ 51	$ 50
Other assets	$ 92	$ 61	$ 34	$ 60	$ 80	$ 65	$ 60	$ 60	$ 65	$ 66	$ 63
Other current liabilities	$ (40)	$ (124)	$ (69)	$ (7)	$ (13)	$ (51)	$ (53)	$ (38)	$ (32)	$ (37)	$ (42)
Total Invested Capital Non-Core Business	$ 557	$ 274	$ 93	$ 286	$ 422	$ 317	$ 336	$ 318	$ 345	$ 343	$ 337

Net of Financial Assets (NFA)	2014	2015	2016	2017	2018	2019	2020e	2021e	2022e	2023e	2024e
Excess Cash	$ 194	$ 342	$ 785	$ 602	$ 359	$ 731	$ 1 033	$ 1 190	$ 1 310	$ 1 378	$ 1 451
Short-term debt	$ (177)	$ (230)	$ -	$ (70)	$ (136)	$ -	$ -	$ (312)	$ -	$ (96)	$ -
Long-term debt, net	$ (2 035)	$ (2 007)	$ (1 435)	$ (1 325)	$ (1 114)	$ (422)	$ (422)	$ (422)	$ (610)	$ (610)	$ (1 014)
Convertible Senior Notes (Debt component)						$ (175)	$ (184)	$ (193)	$ (203)	$ (214)	$ (225)
Capitalized Operating Leases	$ (230)	$ (191)	$ (216)	$ (260)	$ (265)	$ (235)	$ (211)	$ (196)	$ (172)	$ (500)	$ (500)
Total Financial Assets	$ (2 249)	$ (2 086)	$ (866)	$ (1 053)	$ (1 155)	$ (101)	$ 217	$ 67	$ 325	$ (41)	$ (288)

Total Common's Shareholder Equity	$ 187	$ (412)	$ 416	$ 596	$ 1 266	$ 2 281	$ 2 879	$ 2 850	$ 3 252	$ 2 853	$ 2 309

Appendix 3- Cash Flows Forecast (in million $)

Operational Cash Flow Statement	2014	2015	2016	2017	2018	2019	2020e	2021e	2022e	2023e	2024e
NOPLAT (adjusted for operating cash taxes and operating le	$ (150)	$ (282)	$ (366)	$ 567	$ 402	$ 478	$ 1 055	$ 1 661	$ 2 154	$ 2 646	$ 3 084
Depreciation and amortization	$ 258	$ 203	$ 160	$ 175	$ 207	$ 295	$ 397	$ 448	$ 488	$ 509	$ 581
Gross Cash Flow	$ 108	$ (79)	$ (206)	$ 742	$ 609	$ 773	$ 1 452	$ 2 109	$ 2 642	$ 3 154	$ 3 666
Invested Capital- Net PP&E	$ 173	$ 56	$ 109	$ 241	$ 257	$ 285	$ 519	$ 499	$ 522	$ 519	$ 547
Invested Capital - Operating Leases (net)	$ (18)	$ (6)	$ 52	$ 75	$ 42	$ 8	$ 9	$ 15	$ 4	$ 353	$ 71
Invested Capital - Goodwill	$ 320	$ 278	$ 289	$ 289	$ 289	$ 289	$ 289	$ 289	$ 289	$ 289	$ 289
Invested Capital - NWC and Others	$ 1 166	$ 830	$ 480	$ 537	$ 1 118	$ 1 164	$ 1 183	$ 1 353	$ 1 613	$ 1 556	$ 1 627
Investment - Goodwill, Operating Leases, NWC and Others	$ (231)	$ (378)	$ (339)	$ 57	$ 581	$ 47	$ 19	$ 170	$ 260	$ (57)	$ 71
Investment Cash Flow	$ 76	$ 328	$ 178	$ (373)	$ (880)	$ (340)	$ (547)	$ (684)	$ (786)	$ (815)	$ (690)
Free Cash Flow Core Business	$ 184	$ 249	$ (28)	$ 369	$ (271)	$ 433	$ 905	$ 1 425	$ 1 856	$ 2 339	$ 2 976

Non Core Business Cash Flow Statement	2014	2015	2016	2017	2018	2019	2020e	2021e	2022e	2023e	2024e
Non-core Result	$ (234)	$ (320)	$ (138)	$ (19)	$ 69	$ (80)	$ (78)	$ (81)	$ (80)	$ (80)	$ (79)
Invested Capital	$ 557	$ 274	$ 93	$ 286	$ 422	$ 317	$ 336	$ 318	$ 345	$ 343	$ 337
Investment Cash Flow	$ (53)	$ 283	$ 181	$ (193)	$ (136)	$ 105	$ (19)	$ 18	$ (27)	$ 2	$ 6
Free Cash Flow Non Core Business	$ (287)	$ (37)	$ 43	$ (212)	$ (67)	$ 25	$ (97)	$ (63)	$ (107)	$ (78)	$ (73)

Free Cash Flow	$ (104)	$ 212	$ 15	$ 158	$ (338)	$ 458	$ 808	$ 1 363	$ 1 749	$ 2 262	$ 2 902

Non Core Business Cash Flow Statement	2014	2015	2016	2017	2018	2019	2020e	2021e	2022e	2023e	2024e
Non-core Result	$ (234)	$ (320)	$ (138)	$ (19)	$ 69	$ (80)	$ (78)	$ (81)	$ (80)	$ (80)	$ (79)
Invested Capital	$ 557	$ 274	$ 93	$ 286	$ 422	$ 317	$ 336	$ 318	$ 345	$ 343	$ 337
Investment Cash Flow	$ (53)	$ 283	$ 181	$ (193)	$ (136)	$ 105	$ (19)	$ 18	$ (27)	$ 2	$ 6
Free Cash Flow Non Core Business	$ (287)	$ (37)	$ 43	$ (212)	$ (67)	$ 25	$ (97)	$ (63)	$ (107)	$ (78)	$ (73)

Free Cash Flow	$ (104)	$ 212	$ 15	$ 158	$ (338)	$ 458	$ 808	$ 1 363	$ 1 749	$ 2 262	$ 2 902

Financial Cash Flow Statement	2014	2015	2016	2017	2018	2019	2020e	2021e	2022e	2023e	2024e
Financial Result	$ (127)	$ (113)	$ (118)	$ (546)	$ (110)	$ (166)	$ (341)	$ (455)	$ (558)	$ (649)	$ (779)
Net Financial Assets	$ (2 249)	$ (2 086)	$ (866)	$ (1 053)	$ (1 155)	$ (101)	$ 217	$ 67	$ 325	$ (41)	$ (288)
Investment in Net Financial Assets	$ (182)	$ 162	$ 1 220	$ (187)	$ (103)	$ 1 054	$ 318	$ (150)	$ 258	$ (367)	$ (247)
Net Cash Transactions with Shareholders	$ 49	$ 64	$ 1 323	$ 202	$ 345	$ 762	$ (149)	$ (1 057)	$ (933)	$ (1 979)	$ (2 370)
Financing Cash Flow	$ 104	$ (212)	$ (15)	$ (158)	$ 338	$ (458)	$ (808)	$ (1 363)	$ (1 749)	$ (2 262)	$ (2 902)

Appendix 4- Relevered Betas

(In millions, except ratios)

Company Name	Ticker	Market Cap (Equity Value)	Net Debt	Levered Beta	D/E	Unlevered Beta	Relevered Beta
Advanced Micro Devices	AMD	51 070,96	101,30	2,09	0,20%	2,090	1,50
NVIDIA Corporation	NVDA	145 000,00	-923,69	2,05	-0,64%	2,061	1,49
Intel Corporation	INTC	261 000,00	31 204,54	1,34	11,96%	1,225	1,64
Qualcomm, Inc.	QCOM	101 000,00	7 116,38	1,19	7,05%	1,132	1,58
Broadcom Inc.	AVGO	126 000,00	15 515,25	1,27	12,31%	1,157	1,64
Micron Technology, Inc.	MU	60 000,00	2 718,58	1,92	4,53%	1,851	1,55
Xilinx, Inc.	XLNX	24 700,00	-192,47	1,48	-0,78%	1,485	1,49
Analog Devices, Inc.	ADI	44 000,00	6 204,75	1,29	14,10%	1,158	1,66
Texas Instruments Incorporated	TXN	120 000,00	4 382,12	1,35	3,65%	1,314	1,54
Corporate Tax Rate	21%				**Average**	**1,497**	**1,566**
					Median	**1,314**	**1,551**

Appendix 5- Operating Cash Taxes and Operating leases

Operating Cash Taxes	2014	2015	2016	2017	2018	2019	2020e	2021e	2022e	2023e	2024e
Marginal Tax Rate	34,67%	34,83%	35,41%	-287,50%	21,21%	20,92%	20,92%	20,92%	20,92%	20,92%	20,92%
Adjusted EBIT	$ (66)	$ (338)	$ (371)	$ 140	$ 467	$ 633	$ 1 478	$ 1 980	$ 2 498	$ 2 923	$ 3 397
Marginal taxes on EBIT	$ (23)	$ (118)	$ (131)	$ (403)	$ 99	$ 132	$ 309	$ 414	$ 522	$ 611	$ 711
Other operating taxes	$ 1	$ 9	$ (1)	$ -	$ 2	$ 2	$ 2	$ 2	$ 2	$ 2	$ 2
Operating taxes	$ (22)	$ (109)	$ (132)	$ (403)	$ 101	$ 135	$ 311	$ 416	$ 525	$ 614	$ 713
Change in operating deferred-tax assets	$ 106	$ 53	$ 127	$ (24)	$ (36)	$ 20	$ 111	$ (97)	$ (181)	$ (336)	$ (400)
Operating cash taxes	$ 84	$ (56)	$ (5)	$ (427)	$ 65	$ 155	$ 422	$ 320	$ 344	$ 278	$ 312
Operating cash tax rate	-127%	16%	1%	-305%	14%	24%	29%	16%	14%	9%	9%

Operating Leases	2012	2013	2014	2015	2016	2017	2018	2019e	2020e	2021e	2022e	2023e	2024e	2025e
Value of Lease Obligations	$ 314	$ 289	$ 230	$ 191	$ 216	$ 260	$ 265	$ 235	$ 211	$ 196	$ 172	$ 500	$ 500	
Rent Expense	$ 49	$ 64	$ 59	$ 47	$ 39	$ 44	$ 53	$ 54	$ 48	$ 43	$ 40	$ 35	$ 102	$ 102

Appendix 6- Cash and Cash Equivalents (% of Revenues)

Cash and Cash Equivalents (% of Revenues)	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
AMD	24%	24%	16%	31%	9%	13%	10%	16%	15%	20%	29%	23%	17%
NVDA	23%	18%	18%	12%	13%	19%	17%	17%	28%	11%	12%	26%	41%
INTC	19%	19%	9%	11%	13%	9%	16%	11%	5%	28%	9%	5%	4%
QCOM	21%	27%	17%	26%	32%	37%	20%	25%	30%	30%	25%	157%	52%
AVGO	19%	20%	13%	32%	27%	35%	46%	39%	38%	27%	23%	64%	21%
MU	27%	39%	21%	31%	34%	25%	30%	32%	25%	14%	33%	25%	21%
XLNX	45%	35%	47%	58%	56%	52%	35%	29%	41%	38%	23%	41%	88%
ADI	15%	17%	23%	32%	39%	47%	20%	15%	20%	26%	27%	21%	13%
TXN	8%	10%	8%	11%	9%	7%	11%	13%	9%	8%	9%	11%	15%

Appendix 7- 2.125% Convertible Senior Notes

2,125% Convertible Senior Notes	2019	2020	2021	2022	2023	2024	2025	2026
Face Value (millions)	251	251	251	251	251	251	251	251
Coupon (semiannual)	2,125%	2,125%	2,125%	2,125%	2,125%	2,125%	2,125%	2,125%
Effective interest rate	8%	8%	8%	8%	8%	8%	8%	8%
Maturity (years)	7	6	5	4	3	2	1	0
Decomposition								
Payment	2,672	2,672	2,672	2,672	2,672	2,672	2,672	2,672
Periods per year	2	2	2	2	2	2	2	2
Number of periods	14	12	10	8	6	4	2	0
Yield per period	4%	4%	4%	4%	4%	4%	4%	4%
PV of coupons	28,22	25,08	21,67	17,99	14,01	9,70	5,04	0,00
PV of principal	146,73	158,47	171,15	184,84	199,63	215,60	232,85	251,48
Debt component	174,96	183,55	192,82	202,83	213,64	225,30	237,89	251,48
Equity Component	76,52	67,93	58,65	48,64	37,84	26,18	13,59	0,00

Appendix 8- Forward Looking Cost of Equity

Period	SPX 500 Market Value (in $ Billions)	Dividends (in $ Billions)	Dividend Yield	Buybacks (in $ Billions)	Buyback Yield	Dividends & Buybacks (in $ Billions)	Dividend & Buyback Yield	Earnings (in $ Billions as Reported)	Growth Rate
2019e	$23 619	$478,83	2,03%	$729,54	3,09%	$1 208,37	5,12%	$1 151,91	2,9%
2018	$21 027	$456,31	2,17%	$806,41	3,84%	$1 262,72	6,01%	$1 119,43	19,0%
2017	$22 821	$419,77	1,84%	$519,40	2,28%	$939,17	4,12%	$940,86	14,9%
2016	$19 268	$397,21	2,06%	$536,38	2,78%	$933,60	4,85%	$818,55	7,3%
2015	$17 900	$382,32	2,14%	$572,16	3,20%	$954,47	5,33%	$762,74	-16,1%
2014	$18 245	$350,43	1,92%	$553,28	3,03%	$903,71	4,95%	$909,09	1,8%
2013	$16 495	$311,77	1,89%	$475,59	2,88%	$787,36	4,77%	$892,76	
						Average	5,02%	CAGR	4,85%

SPX 500 Px_Last as of Dec 2019	3 230,78
Historical Risk-Free Rate	5,43%
5 Years Growth Rate	4,85%
Long Term Growth Rate	5,43%

	Last 12 months (From Dec 2019)	2020 1	2021 2	2022 3	2023 4	2024 5	Terminal Value (at t5)
Expected Cashflows	162,19	170,05	178,30	186,94	196,01	205,51	4197,57
PV Cashflows		153,77	145,79	138,22	131,05	124,24	2537,71
Intrinsic Value	3230,78						
NPV	0,00						
Implied expected market return	10,59%						
Implied Expected Market Risk Premiun	5,16%						

Appendix 9- ROIC

Return Ratios	2014	2015	2016	2017	2018	2019	2020e	2021e	2022e	2023e	2024e
ROIC w/ Goodwill	-5,84%	-16,02%	-29,45%	34,74%	16,46%	20,08%	41,37%	60,00%	69,64%	77,88%	88,13%
ROIC w/o Goodwill	-6,66%	-19,03%	-38,38%	42,21%	18,67%	22,85%	46,65%	66,99%	76,82%	85,12%	96,06%

Appendix 10- Multiples Valuation

(In millions, except ratios)

Company Name	Ticker	Market Cap (Equity Value)	Beta	D/E	Debt /EBITDA	EV/EBITDA (TTM)	P/E Ratio (TTM)	P/Sales (TTM)
Advanced Micro Devices	AMD	51 070,96	2,09	0,20%	0,46	82,97x	230,04x	8,54x
NVIDIA Corporation	NVDA	145 000,00	2,05	-0,64%	0,94	33,93x	67,09x	14,47x
Intel Corporation	INTC	261 000,00	1,34	11,96%	0,91	8,54x	14,07x	3,71x
Micron Technology, Inc.	MU	60 000,00	1,92	4,53%	0,30	3,72x	17,74x	2,91x
Xilinx, Inc.	XLNX	24 700,00	1,48	-0,78%	1,16	28,42x	27,00x	7,47x
Analog Devices, Inc.	ADI	44 000,00	1,29	14,10%	2,11	17,43x	32,76x	7,34x
Texas Instruments Incorporated	TXN	120 000,00	1,35	3,65%	0,83	11,75x	23,86x	8,15x
Average						17,30x	30,42x	7,34x
Median						14,59x	25,43x	7,41x

Source: Bloomberg

AMD Value	$ 32 174,13	$ 22 583,62	$ 80 277,20
AMD Equity Value	$ 32 459,17	$ 22 732,81	$ 80 562,25
AMD Value per share	$ 29,15	$ 20,41	$ 72,34

Appendix 11- Buyback Prediction

	2020e	2021e	2022e	2023e	2024e
Buyback	$ 148 703 351,57	$ 1 057 000 672,84	$ 932 814 962,33	$ 1 978 815 247,51	$2 369 714 493,84
Shares bought	2 826 083,59	20 088 129,99	17 728 000,28	37 607 069,65	45 036 047,77
Shares outstanding	1 110 801 444,41	1 090 713 314,42	1 072 985 314,14	1 035 378 244,49	990 342 196,72

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Report Recommendations

Buy	Expected total return (including expected capital gains and expected dividend yield) of more than 10% over a 12-month period.
Hold	Expected total return (including expected capital gains and expected dividend yield) between 0% and 10% over a 12-month period.
Sell	Expected negative total return (including expected capital gains and expected dividend yield) over a 12-month period.

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Sensitivity Analysis – Convertible Debt

Analysis of AMD's Convertible Notes

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A Project carried out on the Master in Finance Program, under the supervision of:

Rosário André

3rd December, 2020

Abstract

Since AMD has Convertible Senior Notes in its Debt portfolio, which are a type of Debt that can be converted into Equity, it is important to perceive the impact that an actual conversion (total or partial) may cause on the company's value per share of common stock. Because of this, a Sensitivity Analysis was performed and explained throughout this report. The analysis involves the effect of changes in the principal amount of the 2.125% Convertible Senior Notes, as well as changes in the total number of shares outstanding of the company in its price per share. The main conclusion arrived at this report is that, future possible conversions have low impact on the company's price per share. For the estimated range of prices, the investment recommendation would not change, except for the two lower values (that would give a HOLD recommendation), continuing to be a BUY, as the expected shareholders' return would be still be greater than 10%.

Keywords: Convertible Debt, Principal Amount, Common Stock and Conversion.

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2.125% Convertible Senior Notes

AMD issued on September 14, 2016, a total amount of 700 million dollars in aggregate principal amount of Convertible Senior Notes, with a semi-annual coupon of 2.125% (paid in the beginning of March and September of each year). In addition, the company gave the underwriters a Greenshoe Option[1] to purchase up to an extra amount of 105 million dollars, which was fully exercised a few days later, on September 28. Therefore, AMD counted with a total of 805 million dollars of its Convertible Notes' Face Value (FV). Except if the Notes are converted or repurchased by the company, their maturity date is on September 1, 2026 (10 years of maturity, as most of the other company's debt). The main holders of these Notes are Investment Advisors and Hedge Fund Managers, the top 4 being Hudson Bay Capital Management LP, DLD Asset Management LP, Citadel Advisors LLC and Calamos Partners LLC[2]. Additionally, this type of debt is managed with the help of Wells Fargo Bank, N.A., which works as a trustee.

There are several restrictions and rules established on under what conditions the owners may convert their 2.125% Notes. Firstly, from the period of time between the end of the third quarter of 2016 until the business day prior June 1, 2026 (3 months before the maturity date), they can only be converted if the following circumstances are verified: if the last share price is greater than or equal to 130% of the conversion price (corresponding to an initial conversion price of around $8.00 per share), for at least 20 trading days throughout a period of 30 consecutive trading days (ending on the last trading day of the prior quarter); if during a 10-day period, called the Measurement Period, the stock price per 1000 dollars of principal amount, for each trading day, is smaller than 98% of the product of the last share price and the conversion rate (equal to an initial 125.0031 shares per 1000 dollars of principal amount), and in this case

[1] Source: Bloomberg
[2] Source: Bloomberg

they can be converted on the 5 business days following that period; or still if certain corporate events occur. On the period between June 1, 2026 and the business day prior to the maturity date, the holders can convert their notes at any time, no matter the aforementioned conditions. Furthermore, in case of conversion, AMD may pay the holders cash, may deliver them shares of its common stock, or a mix of both.

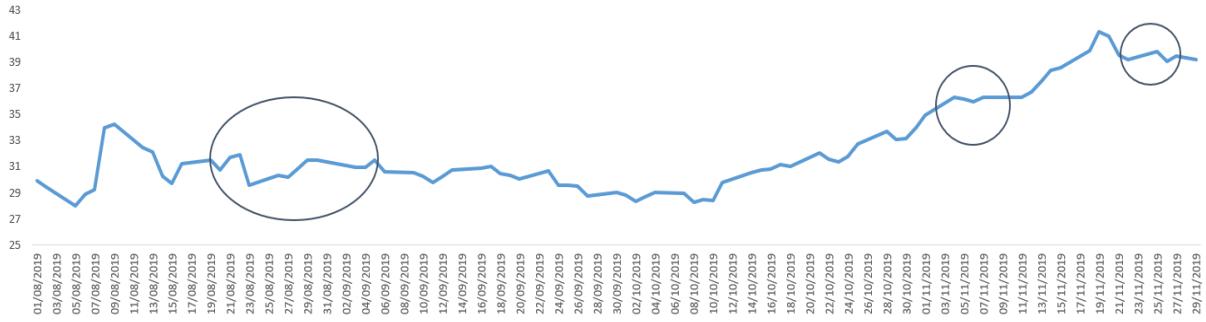
Throughout the last quarter of 2018, the conversion conditions were met and, consequently, the Notes were qualified for conversion on the first quarter of 2019. Again, the same happened during the second and third quarter of 2019, which made the 2.125% Notes eligible for conversion on the third and fourth quarter, at the decision of the owner. Despite this, AMD still had a principal amount outstanding of 805 million dollars, regarding its Convertible Debt, on June 29, 2019[3].

Nonetheless, as of September 28, 2019[4], AMD had only a principal of 679 million dollars of its Notes, meaning that the holders had converted 126 million dollars of principal amount. This conversion (On August 21, 2019 and September 3, 2019)[5] was achieved by a combination of shares and cash. There were issued around 16 million shares of AMD's common stock, at the initial stipulated conversion price of $8.00 per share and it was delivered a payment in cash of approximately 14 million dollars. On November 5, 7 and 8 of 2019 AMD issued entered around 25 million shares of common stock and paid around 21 million dollars in cash for the conversion of an aggregate principal amount of approximately 200 million dollars of Notes[6]. Finally, between November 22 and 27 of 2019, the company issued a total of about 28 million shares of its common stock and delivered an aggregate cash payment of about 22 million dollars, for the conversion of an aggregate principal amount of approximately 228 million

[3] Source: AMD's 2nd Quarterly Report of 2019
[4] Source: AMD's 3rd Quarterly Report of 2019
[5] Source: AMD's Report of unscheduled material events or corporate event - http://ir.amd.com/static-files/88bb3fb0-b7f3-49cf-bc2a-7c83af063527
[6] Source: AMD's Report of unscheduled material events or corporate event - http://ir.amd.com/static-files/ef4aa0f4-2049-4a05-bea6-3408f650bff6

dollars of Debt[7]. Because of this, the company counts now with an aggregate principal amount of 251.475 million dollars of these Notes. In **Exhibit 1**, there are presented the periods of conversion. By analysing the graph, it is possible to notice that the stock price tends to drop (even if too little) after a conversion, but increase back, right after.

Exhibit 1: AMD Stock Price Evolution vs Conversion Periods



Source: Bloomberg

From the latest Quarterly Report of the company, it is possible to perceive that AMD's future intention, in case of a conversion, is to choose only to distribute shares of its common stock to the holders of the Convertible Debt. Therefore, a Sensitivity Analysis was conducted in order to understand how this possible dilution of shares would influence the price per share of the company. The inputs for the analysis were the total number of shares outstanding and the principal amount of the Convertible Notes. On December 31, 2019 the company had approximately 1114 million shares outstanding, thus, the assumptions were that the number of shares will remain the same, changing only in case of conversion, and that all or some of the principal amount of this hybrid security will be converted until the end of 2020. The numbers considered for the principal amount input were the present amount (around 251 million dollars), lowering by itself divided by the remaining years for the maturity of the Notes (6 years- from 2020 to 2026), until it is all converted, reaching an amount of zero. In its turn, the numbers

[7] Source: AMD's Report of unscheduled material events or corporate event -http://ir.amd.com/static-files/6dba73c6-0a39-4399-add8-7e73ef5c8db0

considered for the total shares outstanding input were related with the principal amount, increasing as the Debt is converted into Equity. The value starts at 1111 million[8] and has a maximum amount of approximately 31 million additional shares, reflecting a conversion price of $8 (the same as the initial one defined).

Exhibit 2: Sensitivity Analysis: Convertible Notes' Principal Amount vs Total Shares Outstanding

Share Price	Convertible Notes' Principal Amount							
	$ 251	$ 210	$ 168	$ 126	$ 84	$ 42	$ -
Total Shares Outstanding 1111	$ 52,75	$ 52,77	$ 52,79	$ 52,80	$ 52,82	$ 52,84	$ 52,86
1116	$ 52,64	$ 52,65	$ 52,67	$ 52,69	$ 52,71	$ 52,72	$ 52,74
1121	$ 52,28	$ 52,29	$ 52,31	$ 52,33	$ 52,35	$ 52,36	$ 52,38
1127	$ 51,68	$ 51,70	$ 51,72	$ 51,73	$ 51,75	$ 51,77	$ 51,79
1132	$ 50,87	$ 50,89	$ 50,91	$ 50,92	$ 50,94	$ 50,96	$ 50,97
1137	$ 49,86	$ 49,88	$ 49,90	$ 49,91	$ 49,93	$ 49,95	$ 49,96
1142	$ 48,69	$ 48,70	$ 48,72	$ 48,73	$ 48,75	$ 48,77	$ 48,78

Source: Valuation Model

Considering **Exhibit 2**, and bearing in mind that the target price reached for 31st December of 2020 with the performed AMD's valuation was **$52.75,** it is possible to see that the impact of a conversion is relatively small. The numbers considered should be the ones on the highlighted diagonal as one input implies the other. In this case, a conversion involves a decrease in the principal amount of this security and this, subsequently, implies a dilution of shares, according to the already mentioned assumptions. Cases such as share issues or repurchase of Debt by the company, that may lead to some of the other values, are not being evaluated in this analysis. Consequently, the price range estimated goes from $52.75 to $48.78. As of December 31, 2019, AMD's stock price closed at **$45.86**, giving an expected shareholder's return of 15.03% and, thus, a **BUY** recommendation for investors. In this case, any share price inserted in the defined range would still lead to a **BUY** recommendation, except for the two lower values, that would lead to a **HOLD** recommendation.

[8] Taking into account the prediction of buybacks

In conclusion, the worst-case scenario, regarding the considered inputs, would be a decrease in the estimated future price per share, as of 31st December 2020, of around 7.53% and an expected return of approximately 6.37% to shareholders. The best-case scenario, ceteris paribus, would be that none of this type of Debt was converted until the end of 2020, continuing the price target to be the one arrived at the performed company's valuation.

On the company's main valuation, the value of the Convertible Notes is divided into Debt and Equity Component (Embedded Option).

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